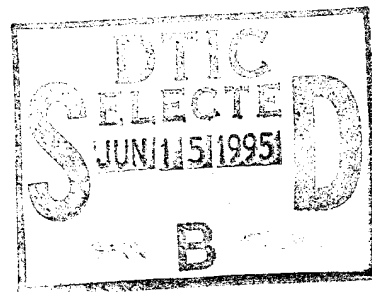DOT/FAA/AM-95/16

Office of Aviation Medicine
Washington, D.C. 20591

# Conversion of the TRACON Operations Concepts Database Into a Formal Sentence Outline Job Task Taxonomy
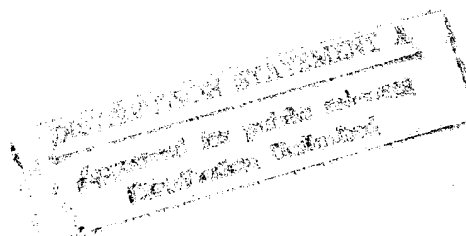
Mark D. Rodgers
Gena K. Drechsler

Civil Aeromedical Institute
Federal Aviation Administration
Oklahoma City, Oklahoma 73125

May 1995

Final Report

U.S. Department
of Transportation

**Federal Aviation
Administration**

19950613 090

| 1. Report No.<br>DOT/FAA/AM-95/16 | 2. Government Accession No. | 3. Recipient's Catalog No. | |
|---|---|---|---|
| 4. Title and Subtitle<br><br>Conversion of the TRACON Operations Concepts Database Into a Formal Sentence Outline Job Task Taxonomy | | 5. Report Date<br><br>May 1995 | |
| | | 6. Performing Organization Code | |
| 7. Author(s)<br><br>Mark D. Rodgers and Gena K. Drechsler | | 8. Performing Organization Report No. | |
| 9. Performing Organization Name and Address | | 10. Work Unit No. (TRAIS) | |
| | | 11. Contract or Grant No. | |
| 12. Sponsoring Agency name and Address<br><br>Office of Aviation Medicine<br>Federal Aviation Administration<br>800 Independence Avenue, S.W.<br>Washington, DC 20591 | | 13. Type of Report and Period Covered | |
| | | 14. Sponsoring Agency Code | |

**15. Supplemental Notes**

**16. Abstract**

*FAA Air Traffic Control Operations Concepts Volume VIII: TRACON Controllers* (1989) developed by CTA, Inc., a technical description of the duties of a TRACON air traffic control specialist (ATCS), formatted in User Interface Language, was restructured into a hierarchical formal sentence outline. To ensure that none of the meaning associated with a task or task element was lost during the conversion, the revised document was reviewed by subject matter experts (SMEs) consisting of four groups of six TRACON controllers and four quality assurance managers. SMEs looked for words, phrases, or acronyms not commonly used by TRACON controllers, and illogical sequencing of duties described in the document. Appropriate suggestions for change were implemented into the document before the next review. Six-hundred seventy-one changes were made to the document, with only seven of these changes made during the final review, confirming that an improved document resulted from the research. The restructured document is intended to assist in the identification of situation awareness information requirements. However, an easily understood, detailed description of duties performed by a TRACON ATCS has potential not only for use by researchers interested in TRACON ATCS tasks, but also by quality assurance investigation teams and training personnel.

| 17. Key Words<br>Air Traffic Control   Human Performance<br>Job Tasks          Human Factors<br>Training | | 18. Distribution Statement<br>Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161. | |
|---|---|---|---|
| 19. Security Classif. (of this report)<br><br>UNCLASSIFIED | 20. Security Classif. (of this page)<br><br>UNCLASSIFIED | 21. No. of Pages<br><br>68 | 22. Price |

**Form DOT F 1700.7** (8-72)      Reproduction of completed page authorized

DTIC QUALITY INSPECTED 5

# ACKNOWLEDGMENTS

# CONVERSION OF THE TRACON OPERATIONS CONCEPTS DATABASE INTO A FORMAL SENTENCE OUTLINE JOB TASK TAXONOMY

## INTRODUCTION

The lack of an easily understood, detailed description of the duties of a Terminal radar approach control (TRACON) air traffic control specialist (ATCS) limits the ability to conduct research on ATCS tasks. Such a description should be detailed enough so that every aspect of the job is well-defined and divided into its fundamental components. The FAA *Air Traffic Control Operations Concepts Volume VIII: TRACON Controllers* (1989), (*Operations Concepts*) developed by Computer Technology Associates (CTA), Inc., defines the operational duties of a TRACON air traffic controller. The document presents a series of operations concepts, that focus on requirements for information exchange between a TRACON controller and the equipment used. *Operations Concepts* was developed to assess the operational suitability of the bidding contractors' design of the Advanced Automation System (AAS). The research described in this document details the restructuring of the CTA TRACON *Operations Concepts* into an easily understood, hierarchically-structured, formal sentence outline.

The *Operations Concepts* document attempted to describe not only the duties of a TRACON controller, but also how the controller performs the job. The document includes composition graphs showing the logical flow of operational tasks, a series of task characterization analyses, a User Interface Language (UIL) that aggregates system input and output messages in a hierarchical organization, and a decomposition of tasks into their constituent procedural elements. The data were designed to be generated and maintained using the Computer-Human Operational Requirements Analysis System (CHORAS), a proprietary data base management system.

The *Operations Concepts* was developed by identifying and defining the air traffic events to which TRACON controllers respond. These responses were identified and reduced to the task element level. Non-operational tasks, such as administrative tasks and tasks related to training, were not included in the *Operations Concepts*. Additional data that applied to TRACON operations were collected through document reviews, site visits, controller interviews, and performance observations. Validation of the data was performed by system users at the Federal Aviation Administration (FAA) Academy and individuals serving at selected TRACON facilities. *Operations Concepts* applied only to FAA TRACON controllers, although CTA developed other volumes for other types of controllers.

The result was a description of the cognitive and behavioral actions involved in performing the duties of a TRACON controller in the form of activities, sub-activities, tasks, and task elements. Activities were defined as top-level operational job functions. Sub-activities described work performance actions at the next level of detail. Tasks, at the next level, were units of work performance. Task elements were components of tasks, describing the systematic steps and actions required to accomplish a task. In the *Operations Concepts*, each level of performance was stated with an action verb, object of the action, and modifiers to describe why, how, where, or when the action was performed.

The information used to develop the restructured taxonomy was extracted from the Task Statements (Appendix B) and the Task Elements (Appendix E) of the *Operations Concepts*. The Task Statements contained activities, sub-activities, and tasks; the Task Elements contained tasks and task elements. *Operations Concepts* was written in User Interface Language (UIL), which used symbols to link together the verbs, objects, and modifiers to yield a descriptive and technical assessment of the controller-system interface. Each item on the Task List was numbered, beginning with the prefix "A1," which indicated the task was a TRACON controller task. The numbers that followed were separated by a decimal, and indicated whether the task was at the activity, sub-activity, task, or task element level (e.g., A1.1.1.1 indicated the item

1

was at the task or third level). The Task Statement was a brief summary of the task to be performed. Descriptive information in the task statement was preceded by an asterisk as follows:

Verb-(modifier)-Object-(modifier)-
(*descriptive information*)

The Task Element Number and the Task Element Statement were formatted the same as the Task Number and the Task Statement.

*Operations Concepts* was formatted in a complex manner to accommodate these purposes; however, it is rather difficult to use in other applications. For instance, research indicated that many of the terms used in CTA's *FAA Air Traffic Control Operations Concepts Volume VI: ARTCC-Host En Route Controllers* were not recognized by experienced ATCSs (Rodgers & Drechsler, 1993); therefore, the TRACON version of the *Operations Concepts* required modifications to improve its readability for use as a research tool. The research described in this document details the restructuring of the CTA TRACON *Operations Concepts* into an easily understood, hierarchically-structured, formal sentence outline to facilitate research involving ATCS tasks. The *Operations Concepts* contained most of the information needed to develop an easily understood, detailed description of the duties of a TRACON controller. To achieve this description, the activities, sub-activities, tasks, and task elements in Appendices B and E of the *Operations Concepts* were combined into a single document. In addition, the Task and Task Element statements were restructured into a hierarchically arranged formal sentence outline. The Coordination Media, Coordinatees, and Position columns in Appendix B (Task Statements) were a tabular presentation of the means of communication and positions involved in performing the task; that presentation was redundant to information contained in the corresponding task element statements and, therefore, was excluded from the restructured document. The Objects and Number of Objects columns in Appendix E (Task Elements) were a tabular summary of the objects listed in the corresponding task element statement and the number of instances a controller would encounter the object in a generic

TRACON facility and time scenario. These were also excluded from the restructuring of the document.

## METHOD

The method was similar to that used in the restructuring in the CTA, Inc. En Route Job Task Taxonomy (Rodgers and Drechsler, 1993). Appendix E from the *Operations Concepts* (September 1989) was obtained from CTA, Inc. in ASCII format, which was converted into a WordPerfect 5.0 file. The information in Appendix B, activities and sub-activities, was manually entered into the document, and the verbs at the sub-activity level were changed from gerund to singular form to remain consistent with the rest of the document. The numbering system was replaced with an alpha-numeric outline format, as follows:

I.   Activity
   A.   Sub-activity
      I.   Task
         a.   Task element

The Verb + Object + Modifier format was maintained in the conversion; however, conjunctions and punctuation were added to form complete sentences. Descriptive information, preceded by an asterisk in the original document, was put in parentheses in the restructured format, as shown in Figure 1. Figure 1 shows the original format of the Task Statements and Task Elements sections of the *Operations Concepts* at the top of the figure with the restructured equivalent in the box at the bottom of the figure.

To ensure that the Task and Task Element statements could be easily understood by TRACON controllers, subject matter expert (SME) review teams consisting of two groups of six controllers from the Atlanta TRACON, one group of six controllers from the Oklahoma City TRACON, and one group of six controllers from the Memphis TRACON, reviewed the restructured taxonomy sequentially. Each of the SME team members reviewed one of six sections of the restructured taxonomy. After each SME team review, the Quality Assurance (QA) manager from that TRACON determined which comments were appropriate for inclusion in the document.

2

During the SME reviews, each controller was given one of the six sections of the restructured taxonomy, along with written instructions (see Figure 2) and the Glossary of Controller Task Action and Task Element Verbs from Appendix C of the FAA *Air Traffic Control Operations Concepts Volume I: ATC Background and Analysis Methodology* (see Appendix A). Each member was instructed to look for words, phrases, or acronyms not commonly used by TRACON controllers, redundant statements within a task, and missing tasks and task elements. The reviewers were instructed to write comments or suggestions in the margins of the document. Approximately an hour and a half was given to complete the review; an experimenter monitoring the review was present in the room. After each review, the QA manager determined which comments and suggestions were appropriate for inclusion in the document. Those changes were implemented into the document before printing it for the next SME review group.

## RESULTS

Since the individual sections of the restructured taxonomy are not directly comparable to each other due to differences in subject matter and length, a descriptive presentation of the results of this research was deemed most appropriate. Table 1 contains the frequency of suggested changes that were incorporated into each section of the document and for each trial, and the percentage of changes incorporated into the document across each section of the document.

Depending on the section of the document, between 62% and 96% of the changes were made during the first review as shown in Table 1. A little over 1% of the total document changes resulted from suggestions made during the last review. The final version of the restructured taxonomy is presented in Appendix B.

## DISCUSSION

*Operations Concepts* is an excellent description of the duties performed by a TRACON controller; however, the complex format makes it difficult to use for purposes other than that for which it was originally intended. *Operations Concepts* was primarily meant to

be used with the CHORAS software routines developed by CTA to evaluate the operational suitability of the bidding contractors' design of the AAS. The intent was to ensure that the suggested design provided for effective dialogue between the controller and the automated system throughout the phases of its development. The *Operations Concepts* utilized CTA's User Interface Language (UIL) for the presentation of the job task taxonomy, which is unacceptable for use as a training tool or as stimulus materials in a research effort. Additionally, acronyms and terms not familiar to many controllers were used in the original document. For example, "G/G communications" was changed to "ground-to-ground communications" in the new document, a term with which TRACON controllers were more familiar. Furthermore, several SMEs indicated that some of the tasks performed by a controller were not included in the *Operations Concepts*, although some of those tasks were found in other sections of the document that were reviewed by other SMEs. An example of an addition made to the document, in section IV.J., was the task and two task elements that follow:

4. Detect readback of issued clearance.
    a. Detect whether readback of issued clearance is correct.
    b. Transmit clearance until readback is correct.

This task may not have been considered vital in evaluating the operational suitability of the contractors' design of the AAS, but was crucial in considering other issues, such as the identification of task elements involved in operational errors. Further modifications of the document may be required to meet demands of future research efforts.

The restructuring of the *Operations Concepts* into a formal sentence outline was intended to make the document more useful to persons interested in reviewing the tasks a controller performs. It should be noted that redundant information contained in the original document was omitted from the restructured document. Only the activities, sub-activities, tasks, and task elements were included in the restructured taxonomy. The document was reduced in this fashion

## ORIGINAL FORMAT

### TASK STATEMENTS

| Task Number | Task Statement | Coordination Media | | | Coordinates | | | | | | | | | | | | | | Positions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Voice | Function | Message | En Route Controller | Area Supervisor | Terminal Specialist | Flight Service | Traffic Management | Mission Coordinator | Airway Facility/OSC | Meteorologist | Pilot | Tower Controller/Sup | Central Flow Control | Aeronautical Radio | Base Operations | Other Coordination | Radar Controller | Coordinator | Handoff | Flight Data | |
| A1.4 | ROUTE OR PLAN FLIGHTS | | | | | | | | | | | | | | | | | | | | | | |
| A1.4.1 | PLANNING CLEARANCES | | | | | | | | | | | | | | | | | | | | | | |
| A1.4.1.10 | REVIEW POTENTIAL IMPEDIMENTS FOR IMPACT ON PROPOSED CLEARANCE | | | | | | | | | | | | | | | | | | | R | | | |

### Task Elements

| TASK NUMBER / ELEMENT NUMBER | TASK STATEMENTS / DATA AND TASK ELEMENT STATEMENTS | OBJECTS | NO. OF OBJECTS |
|---|---|---|---|
| A1.4.1.10 | REVIEW POTENTIAL IMPEDIMENTS FOR IMPACT ON PROPOSED CLEARANCE | | |
| | TASK TYPE: R/A     COORD MEDIA:     FREQUENCY: HI     CRITICALITY: MED | | |
| A1.4.1.10.1 | ACQUIRE _Target_Position_Symbol, _Data_Block, _Obstruction, _Precipitation *weather return* on _Radar_Display for information pertaining to impact on proposed clearance | Target_Position_Symbol | 30 |
| | | Data_Block | 30 |
| | | Obstruction | 3 |
| | | Precipitation | 1 |
| | | Radar_Display | 1 |
| | A/O | | |
| A1.4.1.10.2 | ACQUIRE _Flight_Progress_Strip in _Flight_Strip_Bay for information pertaining to factors which will impact proposed clearance | Flight_Progress_Strip | 20 |
| | | Flight_Strip_Bay | 1 |
| | A | | |
| A1.4.1.10.3 | *ACQUIRE pertinent flow restriction information from _Traffic_Management_Record | Traffic_Management_Record | 1 |

## RESTRUCTURED FORMAT

IV.   Route or plan flights.
    A.   Plan clearances.
        1.   Review potential impediments for impact on proposed clearance.
            a.   Acquire target position symbol, data block, obstruction, and precipitation (weather return) on radar display for information pertaining to impact on proposed clearance.
            b.   Acquire flight progress strip in flight strip bay for information pertaining to factors which will impact proposed clearance.
            c.   Acquire pertinent flow restriction information from traffic management record.

**FIGURE 1.  Original format of the *Operations Concepts* compared to the restructured equivalent.**

## BACKGROUND & INSTRUCTIONS
## FOR SUBJECT MATTER EXPERT REVIEW OF MODIFIED CTA TASKS TAXONOMY

The following is an outline of activities involved in performing the job of a TRACON air traffic controller. These activities were extracted from *FAA Air Traffic Control Operations Concepts Volume VIII: TRACON Controllers,* which was prepared by Computer Technology Associates (CTA), Inc., in Colorado Springs, Colorado. The document is based on data gathered during site visits to TRACON facilities by a team of currently active controllers and supervisors. The result is a description of the job activities of a TRACON air traffic controller in a "generic" TRACON.

Each job activity has been broken down into sub-activities, tasks, and task elements. In some cases, task elements are performed sequentially and others may be performed simultaneously. The task elements may be performed more than once during the activity, but not all task elements are performed on every position or in all sectors. **This document is not intended to tell how a TRACON air traffic controller should do the job, but to describe in detail the actions that occur while the job is being performed.**

Originally, the document was not written in a narrative format, and the activities, sub-activities, tasks, and task elements were not organized in a formal outline manner. For research purposes, the Performance Assessment Section (AAM-514) has changed the format of the original document to one that is narrative and hierarchical in nature. Changes were made in wording, and punctuation was added to make the document more readable.

Each person has 1 of 6 sections of the complete document. We would like you to read your section of the document and look for unfamiliar phrases or acronyms or statements that seem redundant within a task element. Please write any comments or suggestions in the margins. It should take approximately 1H hours to review the document. Thank you for your time and comments.

**FIGURE 2. Instructions given to Subject Matter Experts.**

**TABLE 1. Frequency of Suggested Changes Implemented into the Restructured Job Task Taxonomy.**

| | Section of Document | | | | | | |
|---|---|---|---|---|---|---|---|
| Review | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| ATL-1 | 24 | 80 | 100 | 175 | 54 | 164 | 597 |
| ATL-2 | 15 | 6 | 6 | 21 | 4 | 7 | 59 |
| OKC | 0 | 0 | 0 | 3 | 5 | 0 | 8 |
| Memphis | 0 | 1 | 2 | 2 | 2 | 0 | 7 |
| Total | 39 | 87 | 108 | 201 | 65 | 171 | 671 |
| % of Total Document Change | 6 | 13 | 16 | 30 | 10 | 25 | |

so as to ensure readability. It should also be noted that those items were contained in two separate appendices of the *Operations Concepts*. The results indicate that the restructuring of the document was a success. The document underwent 671 changes before it was considered to be both free of unfamiliar acronyms and phrases, and complete in regard to the tasks and task elements it details. Suggestions made during the first of the four trials accounted for 89% of the total document changes, whereas suggestions made during the last of the four trials accounted for only 1% of the total document changes. This indicates that the document was much more understandable to the subjects used in this investigation after the review trials were completed.

The restructured document has the potential for use not only by researchers interested in TRACON ATCS tasks, but also by training personnel and quality assurance investigation teams. One use of the restructured taxonomy, the use for which the restructuring was intended, is to assist in the identification of the tasks and task elements that were either not performed or were performed incorrectly by an air traffic controller who commits an operational error. By having a detailed description of the duties to be performed, it should be possible to identify those tasks related to operational error involvement. It may be that certain tasks are commonly involved in the commission of an operational error. One possible use for such information would be to provide guidance to further investigate tasks with regard to their potential for automation or develop an automated aid to assist in performing the tasks.

This information would also help quality assurance teams conducting investigations after the occurrence of an operational error. By having a detailed description of the sequence of duties that should be performed in a given situation, it might be easier for the quality assurance team to identify the tasks and task elements not performed or performed incorrectly. This could assist not only quality assurance teams in more definitively describing the circumstances resulting in an operational error, but should also assist the controller who committed the error and other controllers at the facility to become more aware of the problems that develop when a given set of tasks or task elements is not performed, or is performed incorrectly. Further research is required to determine the extent to which the document is usable for the identification of tasks involved in the commission of operational errors.

The potential for the restructured taxonomy to be used as a training tool would appear to be an area that also deserves further investigation. If it is possible to identify the tasks that were not performed or were performed incorrectly during the commission of an operational error, then training exercises could be developed that correspond directly to the tasks in which an ATCS appears to be deficient. Additionally, it might be useful for air traffic control students to see the listing of the tasks they will be expected to perform when they become operational controllers. By providing an organized presentation of the duties students will be expected to perform, a more global understanding of the job might be achieved sooner than if this information had to be obtained from several different sources and across different types of media.

It would appear that a considerably improved document, particularly in regard to readability, has resulted from this effort. The document may be used for many other purposes other than those mentioned in this report. Other CTA job task taxonomies are available for En Route and Tower air traffic controllers. The En Route taxonomy has been modified, using the methodology presented in this report (Rodgers & Drechsler, 1993) and has been used to initiate a program of research on situation awareness (Endsley & Rodgers, 1994). An analysis of the restructured CTA job task taxonomy was performed to determine the specific situation awareness information requirements for En Route air traffic control. A similar effort to determine the situation awareness information requirements for the TRACON environment is underway.

# REFERENCES

Computer Technology Associates, Inc. (1987). *FAA Air Traffic Control Operations Concepts Volume I: ATC Background and Analysis Methodology* (CDRL B112). Englewood, CO: Author.

Computer Technology Associates, Inc. (1990) *FAA Air Traffic Control Operations Concepts Volume VI: ARTCC-Host En Route Controllers* (CDRL 011). Englewood, CO: Author.

Computer Technology Associates, Inc. (1990). *FAA Air Traffic Control Operations Concepts Volume VIII: TRACON Controllers* (CDRL B112). Englewood, CO: Author.

Endsley, M.R., & Rodgers, M.D. (1994). *Situation Awareness Information Requirements for En Route Air Traffic Control.* (DOT/FAA/AM-94/27). Washington, DC: Federal Aviation Administration Office of Aviation Medicine.

Rodgers, M.D., & Drechsler, G.K. (1993). *Conversion of the CTA, Incorporated En Route Operations Concepts Database into a Formal Sentence Outline Job Task Taxonomy.* (DOT/FAA/AM-93/1). Washington, DC: Federal Aviation Administration Office of Aviation Medicine.

**APPENDIX A**


Definitions of Verbs in the TRACON Formal Sentence Outline Job Task Taxonomy*

ACCEPT | Respond to an originating controller or computer message, indicating that the receiving controller assumes complete or partial responsibility for the requested action, as appropriate.

ACQUIRE | Gather in or perceive via detection, scanning, search, extraction, or cross-reference.

ADJUST | Change or fine-tune a data base, controls, display, and/or communication control.

ANALYZE | Examine methodically so as to determine the nature and components of a matter.

APPROVE | Respond favorably to a request as a person in authority, as in approving a clearance request.

ASSESS | Consider via comparison or evaluation.

BRIEF | Give concise preparatory information concerning all sector or position activities and the operational situation to another person, as when turning over responsibility for a position.

BROADCAST | Transmit a recording or voice message to a general audience (as opposed to contacting a specific person) via radio.

CHECK | Visually examine a hardware item to establish its operational state or condition.

CHOOSE | Make a mental decision on a course of action or mentally pick one of several alternatives, as in choosing a desired flow sequence.

COMPARE | Relate one item to another to note relative similarities and/or differences, as in comparing a maintenance request to a maintenance schedule.

CONDUCT | Accomplish a series of related actions to achieve a definite goal, as in conducting a radio/radar search for aircraft.

COPY | Reproduce one or more duplicates of an entity (i.e., with no links to the "master").

CROSS-REFERENCE | Accessing or looking up related information, usually by means of an indexing or organized structuring scheme set up for that purpose.

DECIDE | Arrive at an answer, choice, or conclusion.

| | |
|---|---|
| DECLARE | State with emphasis that a situation exists, as in declaring the existence of an emergency event. |
| DELETE | Remove an information item (as in deleting the highlighting of an item on a display) or cancel a previous action (as in canceling a request for pilot position reports). This includes verbal actions as well as computer information. |
| DENY | Refuse to grant a request. |
| DETECT | Discern visually or aurally a newly occurring fact or item (not being watched for, i.e., not the object of preceding attention), usually from a display, such as an alarm indicator or the action of an aircraft target symbol. |
| DETERMINE | Process information mentally to reach a decision about a situation, state of affairs, or the timing of an action. |
| DISCUSS | Exchange information/ideas on a particular topic with one or more others, typically not involving a resolution of differences. |
| ENTER | Insert data, text, or a system message into the computer system. |
| ESTIMATE | Mentally gauge, judge, or approximate, often on the basis of incomplete data. |
| EVALUATE | Examine and judge the merits of an action or situation for a definite purpose and to reach a decision. |
| EXECUTE | Initiate or activate any of a set of predefined utility or special-purpose functions. |
| EXTRACT | Directed, attentive reading, observing, or listening with the purpose of gleaning the meaning of the contents thereof. |
| EXTRAPOLATE | Assign an approximate value to a future point based upon the value(s) of preceding point(s). Also, mentally extend or estimate the position and/or path of one or more mobile objects in time and space. |
| FLIGHT-FOLLOW | Provide advice and information to assist pilots in conduct of a flight not otherwise being controlled, to include tracking that flight on the Situation Display. |
| FORMULATE | Mentally compose or prepare the content of a verbal or computer input message or plan, including all required or pertinent elements thereof, such as an advisory or clearance. |

FORWARD            Send information verbally or electronically to another position.

INFORM             Impart information to another person.

INHIBIT            Prevent the occurrence of a machine function, as in inhibiting an alert function.

INITIATE           Begin an action or sequence, as in initiating a handoff or starting a track.

INTEGRATE          Pull together, and mentally organize, a variety of data elements so as to extract the information contained therein.

ISSUE              Distribute or communicate information as guidance to a pilot or vehicle operator by radio, as in issuing clearances, alerts, and advisories.

NEGOTIATE          Confer in order to come to a mutually acceptable agreement, as when negotiating with a pilot the technique to be used for accomplishing a flight delay.

OBSERVE            Take notice visually or watch attentively something or somewhere for an expected message, object, event, or occurrence of something.

OFFSET             Relocate the position of a Data Block in adapted increments in relation to its associated target on the display.

PERCEIVE           Recognize an action or situation as it evolves over time in the absence of any specific indicator, such as an aircraft deviation or a tracking fault.

PERFORM            Carry out an action.

PROJECT            Mentally extend or estimate the position and/or path of one or more mobile objects, such as aircraft or ground vehicles, in time and space.

QUERY/QUESTION     Inquire of another person or of a computer to gain information to remove doubt, as in querying a pilot about some element of a flight plan.

REASSOCIATE        Reposition a Data Block with its intended target when it has become disassociated from it.

RECEIVE            Acquire transmitted messages by seeing or listening, without necessarily taking action to express approval or receipt.

RECOGNIZE          Specific, positive identification of an entity.

RECORD | Make a permanent or written note of an event or observation, as in recording a weather observation.

REDIRECT | Retract handoff initiated to one controller and reinitiate it to another controller.

REMOVE | Excise via cutting or deletion.

REQUEST | Ask another individual for information on, approval of, or for receipt of something. Also, direct the system to provide a function such as route readout or beacon code.

RESEQUENCE | Rearrange the order of Flight Data Entries displayed.

RESPOND | Answer or reply in reaction to a message input.

RESTORE | Bring back into being or remove an inhibit of a function such as MSAW or the display of certain information.

RETRACT | Take back, negate, or withdraw the start of an action already begun, such as a handoff.

REVERT | Go to the use of an alternate procedure, such as backup operations.

REVIEW | Look over and study conditions or situations, or reexamine something, as in reviewing the completeness of a flight plan. Also appropriate for absorbing information to maintain a dynamic picture of present and/or future traffic, or the status of some equipment.

SCAN | Glance over quickly, usually looking for overall patterns or anomalous occurrences.

SEARCH | Scan/look over a display or area to locate something, such as a particular Flight Data Entry.

SELECT | Single out an item in preference to others on a display or panel, or pick one of several available system options or items and inform the system of the choice.

SIGN OFF | Carry out a standard procedure to inform the system that one is no longer operating at a particular control workstation.

SIGN ON | Carry out a standard procedure to establish oneself as operating at a particular control workstation.

SUGGEST | Offer another course of action for consideration when a request is not feasible, such as clearance alternatives to a clearance request.

| | |
|---|---|
| **SUPPRESS** | Curtail the display of an item, such as a Full Data Block after a pointout. Such display may be restored at some later time. |
| **SWITCH** | Change a given system condition to another available condition, as when switching communications to a backup frequency. |
| **SYNTHESIZE** | Mentally produce new information via estimation, interpolation, translation, integration, formulation, or projection/extrapolation. |
| **TERMINATE** | Bring an action to an end, as in terminating radar service to an aircraft. |
| **UPDATE** | Change or modify text or data to make it more up-to-date, as in updating electronic reminder notes. |
| **VALIDATE** | Determine that an automatic altitude readout varies less than 300 feet from pilot-reported or known altitude. |
| **VERIFY** | Establish the truth of an activity or matter by confirming that a particular situation or matter is in the expected state. For example, verifying pilot compliance with a clearance, or confirming the occurrence of specific computer actions during transition stages. |

# APPENDIX B

Formal Sentence Outline Job Task Taxonomy

## TABLE OF CONTENTS

## ACRONYMS

| | |
|---|---|
| ARSA | Airport Radar Service Area |
| ARTS | Automated Radar Terminal System |
| ATC | Air Traffic Control |
| ATCT | Airport Traffic Control Tower |
| ATIS | Automatic Terminal Information Service |
| CA | Conflict Alert |
| ECM | Electronic Counter Measure |
| FDB | Full Data Block |
| FDIO | Flight Data Input/Output |
| FSS | Flight Service Station |
| IFR | Instrument Flight Rules |
| MSAW | Minimum Safe Altitude Warning |
| NAVAID | Navigational Aid |
| NORDO | No Radio |
| NOTAM | Notice to Airmen |
| PIREP | Pilot Weather Report |
| VFR | Visual Flight Rules |
| TCA | Terminal Control Area |
| TRSA | Terminal Radar Service Area |

I. Perform situation monitoring.

   A. Check and evaluate separation.

      1. Review flight strip bay for present and/or future aircraft separation.
         a. Acquire flight progress strip from flight strip bay and time from digital clock or radar display for information pertaining to aircraft separation.
         b. Synthesize aircraft, position, route, speed, and altitude into a mental picture of aircraft separation.
         c. Recognize aircraft paths warranting further close monitoring and evaluation.

      2. Review radar display for potential violation of aircraft separation standards.
         a. Acquire target position symbol, full data block, limited data block, secondary target, and primary target on radar display for potential separation violation.
         b. Acquire obstruction on video map of radar display for influence on potential separation violation.
         c. Synthesize altitude, speed, range, and aircraft data into a mental traffic picture with regard to potential violation of aircraft separation standards.
         d. Recognize potential violation of aircraft separation standards.

      3. Project mentally an aircraft's future position/altitude/path.
         a. Acquire target position symbol, full data block or limited data block, and precipitation (weather return) on radar display to project aircraft's future position.
         b. Acquire primary target or secondary target and target history on radar display to project aircraft's future position.
         c. Acquire obstruction and airspace boundary on video map on radar display for influence on projection of aircraft future position.
         d. Acquire flight progress strip from flight strip bay to assess aircraft flight progress.
         e. Synthesize location, route, speed, and altitude on specified aircraft into a mental picture of future position, altitude, or path.
         f. Project future location, altitude, and/or path of aircraft, possibly with regard to proximity to other aircraft, obstructions, special use airspace, and weather.

      4. Determine whether aircraft will be separated by less than prescribed minima.
         a. Evaluate current and projected mental traffic picture to determine potential situations of less than standard separation.
         b. Decide whether aircraft separation will be less than minimum.

      5. Review radar display for potential violation of airspace separation standards.
         a. Acquire target position symbol, full data block, limited data block, primary target, and precipitation on radar display for info pertaining to potential airspace conflict.
         b. Acquire boundary (airspace) and minimum vector altitude on video map of radar display.
         c. Synthesize altitude, route, weather, and special use airspace into a mental traffic picture with regard to violation of airspace separation standards.
         d. Recognize potential violation of airspace separation standards, and potential airspace conflict.

      6. Review radar display for potential violation of conformance criteria.

    a. Acquire target position symbol, data block, video map, and precipitation on radar display for information on potential violation of altitude or lateral conformance.

    b. Acquire altitude in full data block and airway/route and minimum vector altitude on video map for information on potential violation of altitude or lateral conformance.

    c. Synthesize aircraft altitude, route, and speed into a mental traffic picture with regard to potential violation of conformance criteria.

    d. Recognize potential violation of altitude, speed, or route conformance criteria.

7. Determine whether airspace separation standards may be violated.

    a. Decide by mentally projecting the traffic picture if the potential exists for less than standard separation between an aircraft and special use airspace.

8. Determine whether flow restrictions may be violated.

    a. Decide by projecting the traffic picture mentally, if the potential exists for instances of non-compliance with flow control restrictions.

9. Review displays/records for potential violation of flow restrictions.

    a. Acquire target position symbol and full data block on radar display for aircraft route of flight and information pertaining to potential violation of flow restrictions.

    b. Acquire flight progress strip from flight strip bay for aircraft route of flight and information pertaining to potential violation of flow restrictions.

    c. Acquire flow restriction note in traffic management record for traffic management information.

    d. Synthesize mental traffic picture with regard to flow violations from aircraft position, altitude, route, speed, and traffic management information.

    e. Recognize potential violation of flow restrictions.

10. Request beacon code/mode C readout of unassociated target.

    a. Initiate beacon code/mode C/speed readout message on unassociated target.

    b. Execute beacon code/mode C/speed readout message.

    c. Extract beacon code, mode C altitude, and speed (ground speed) in appropriate limited data block.

11. Quick look at full data blocks to examine track information on aircraft.

    a. Initiate activation of quick look button to force radar data from adjacent airspace to radar display.

    b. Execute activation of quick look button message.

    c. Extract full data block (quick look) on radar display from another sector.

12. Observe track history to project aircraft movement.

    a. Acquire target history (fading previous target returns) for specific aircraft on radar display.

13. Enter flight progress strip request.

    a. Initiate flight progress strip request for specified aircraft.

    b. Execute flight progress strip request message on FDIO system.

14. Enter flight plan readout request.

    a. Initiate request of flight plan readout for specific aircraft.

    b.  Execute request of flight plan readout message on FDIO system.

  15. Request flight progress strip verbally.
    a.  Initiate ground-to-ground communications (request for a flight progress strip on an aircraft).

B.  Receive system status information.

  1.  Record airport environmental/system equipment status change.
    a.  Copy status information for record system status change on system status data record.
    b.  Copy status information for record controller note as reminder to controller.

  2.  Detect airport environmental/system equipment interruption/restoration.
    a.  Search system equipment displays for signs of system interruption/restoration.
    b.  Detect failure of full data block, partial data block, and/or target position symbol on radar display.
    c.  Detect failure of FDIO monitor, flight strip printer, or alphanumeric keyboard to operate properly.
    d.  Detect failure of airport environmental instrument to display reasonable readout.
    e.  Detect proper updating of full data block, partial data block, and/or target position symbol on radar display.
    f.  Detect proper operation of FDIO monitor, flight strip printer, or alphanumeric keyboard.
    g.  Detect reasonable or proper readout of airport environmental instrument.

  3.  Observe record of new/changed airport environmental/system equipment status.
    a.  Scan system status data record for new or revised equipment status changes.
    b.  Detect new or updated equipment status report on system status data record.
    c.  Extract new or changed equipment status from system status data record.

  4.  Receive notice of new/changed airport environmental/system equipment status.
    a.  Receive ground-to-ground communications (status of airport environmental equipment or system equipment).
    b.  Perform air/ground communication (pilot notice of NAVAID status).

  5.  Perceive airport environmental/system equipment status indicator change.
    a.  Detect change of equipment status indicator reflecting status of an equipment item.

  6.  Forward airport environmental/system equipment status record/notice.
    a.  Execute manual transmission of paper record to forward equipment status record to others in the approach control room.
    b.  Initiate enter IDS change message.
    c.  Execute enter IDS change message to report equipment status on facility IDS display screens.

C.  Analyze initial requests for clearance.

  1.  Search flight strip bay for inactive flight plan on clearance request.

a. Search flight progress strip and computer identification number for aircraft identification of aircraft requesting clearance.

b. Extract aircraft identification, computer identification number, and assigned beacon code from flight progress strip in flight strip bay.

c. Compare aircraft identification and control information symbol on flight progress strip for agreement regarding proposed clearance request.

2. Request flight plan readout verbally.
   a. Initiate ground-to-ground communications (request readout of flight data from another controller).

3. Request pilot to file/refile flight plan.
   a. Perform air/ground communication (inform pilot to file or refile flight plan).

D. Process departure/en route time information.

1. Enter departure/en route time message.
   a. Initiate departure aircraft, flight plan amendment, or update flight plan message into FDIO system (manually enter departure time or en route time message into flight data base).
   b. Execute departure aircraft, flight plan amendment, or update flight plan message.

2. Initiate track start manually.
   a. Initiate start track message.
   b. Execute start track message.
   c. Initiate start track file message.
   d. Execute start track file message.
   e. Detect target position symbol and full data block on the radar display (results of track start message).

3. Observe automatic track start.
   a. Scan radar display for automatic track start.
   b. Detect full data block correlated with target position symbol.

4. Observe emphasized (flashing) departure message.
   a. Scan full data block on departing aircraft for attention indicator of presence of departure message.
   b. Detect blinking field in full data block denoting departure message for aircraft.

5. Forward departure/en route time message.
   a. Initiate ground-to-ground communications (forward departure or en route time message).

6. Receive departure/en route time notice/strip.
   a. Receive ground-to-ground communications (aircraft departure or en route time notice).
   b. Perform air/ground communication (aircraft departure or en route time notice from pilot).
   c. Detect aircraft departure time information on departure strip received from flight strip printer or gravity tube (from the tower).

    d. Detect automatic acquisition on radar display of aircraft departing airport.

7. Delete departure message emphasis (flashing).
    a. Initiate inhibition of blinking departure message to delete emphasis indicator in full data block.
    b. Execute inhibition of blinking departure message.
    c. Detect deletion of departure message attention indicator in full data block of departing aircraft.

E. Process requests for flight following.

1. Evaluate conditions for providing flight following.
    a. Acquire full data block on radar display for information pertaining to workload and capability to provide flight following.
    b. Acquire traffic information on arrival/departure list on radar display.
    c. Acquire precipitation on radar display and weather conditions on meteorological record, information display system, or system status data record.
    d. Acquire traffic information on flight progress strip in flight strip bay.
    e. Synthesize current and projected aircraft and weather information into a mental traffic picture regarding anticipated workload.
    f. Decide feasibility of providing flight following service.

2. Inform pilot of alternate instructions necessary for flight following service.
    a. Perform air/ground communication (advise pilot of alternate instructions to enhance conditions for flight following).

3. Receive request for flight following.
    a. Perform air/ground communication (pilot requests flight following).
    b. Receive ground-to-ground communications (flight following request relayed from another position).

4. Deny flight following request.
    a. Perform air/ground communication (denial of flight following request from pilot).
    b. Initiate ground-to-ground communications (denial of flight following request relayed by controller).

5. Approve flight following request.
    a. Initiate display track.
    b. Execute display track.
    c. Detect appearance of full data block on radar display.

F. Housekeeping.

1. Suppress data block from display.
    a. Initiate inhibition of track function.
    b. Execute inhibition of track function.
    c. Detect removal of appropriate full data block from radar display.

2. Restore data block to radar display.
    a. Initiate display track.

    b.  Execute display track.

    c.  Detect appearance of full data block on radar display.

3. Delete scratch pad data in full data block.
   a. Initiate deletion of scratch pad message.
   b. Execute deletion of scratch pad message.
   c. Recognize removal of scratch pad data from full data block.

4. Remove obsolete (deadwood) paper records or recorded data.
   a. Search paper records for currency.
   b. Execute removal of paper records for deadwood no longer needed.

5. Offset a data block.
   a. Initiate offset of FDB.
   b. Execute offset of FDB.
   c. Detect appropriate movement of full data block on radar display.

6. Update/revise controller note.
   a. Execute recording controller note (update/revise).

7. Delete controller note.
   a. Execute removal of controller note (deadwood).

8. Record strip marking on flight progress strip/record.
   a. Execute recording flight strip entry on strip or record for desired/required strip markings.

9. Resequence flight progress strip/record manually.
   a. Execute manually order/sequence of FPS for preferred order/posting.

II. Resolve aircraft conflicts.

    A. Perform aircraft conflict resolution.

        1. Detect aircraft conflict alert indication or alarm.
           a. Scan radar display for presence of alert indication.
           b. Detect MSAW/CA alert (conflict alert) in full data block on radar display with associated aural alarm for potential alert situation.
           c. Detect aircraft identification and alert message (conflict alert) in MSAW/CA alert list on radar display.
           d. Request supervisor permission for suppression of MSAW/CA.

        2. Determine validity of potential aircraft conflict notice or indication.
           a. Integrate speed, altitude, conflict, and route with regard to the current/projected proximity of the aircraft involved.
           b. Compare apparent situation with intended pilot action and/or planned control actions.
           c. Assess validity of conflict alert indication or notice in consideration of the mental traffic picture.

        3. Receive notice of potential aircraft conflict in sector.
           a. Receive ground-to-ground communications (notice of potential aircraft conflict).
           b. Perform air/ground communication (pilot notice of potential aircraft conflict).

        4. Inform controller of potential aircraft conflict in his sector.
           a. Initiate ground-to-ground communications (potential aircraft conflict in other sector).

        5. Review potential conflict situation for resolution.
           a. Acquire target position symbol, data block, target history (of aircraft involved), and MSAW/CA alert list on radar display regarding potential conflict.
           b. Acquire flight progress strip (route and aircraft information) in flight strip bay.
           c. Synthesize altitude, speed, and direction of travel into a mental traffic picture with regard to the separation of the potential conflict aircraft.
           d. Evaluate need/means to resolve potential aircraft conflict.

        6. Determine appropriate action to resolve aircraft conflict situation.
           a. Decide upon action needed to resolve aircraft conflict situation considering mental traffic picture and available conflict resolution options.

        7. Perceive potential aircraft conflict situation.
           a. Acquire target position symbol, full data block and limited data block on the radar display for potential violation of separation standards.
           b. Synthesize altitude, speed, and route into a mental traffic picture (with regard to potential aircraft conflict situations).
           c. Recognize potential aircraft conflict situation.

        8. Receive pilot notice of traffic in sight.
           a. Perform air/ground communication (pilot reports traffic in sight).

        9. Forward notice of aircraft conflict to supervisor.

a.  Initiate ground-to-ground communications (notify supervisor of aircraft conflict).

B.  Perform minimum safe altitude processing.

1.  Detect MSAW indication or alarm.
    a.  Scan radar display for presence of MSAW situation.
    b.  Detect MSAW/CA alert (low altitude) in full data block on radar display (with associated aural alarm).
    c.  Detect aircraft identification and alert message (low altitude) in MSAW/CA alert list on radar display.
    d.  Request supervisor permission for suppression of MSAW/CA.

2.  Recognize notice of potential low altitude situation in sector.
    a.  Receive ground-to-ground communications (notice of potential low altitude situation).

3.  Inform controller of potential low altitude situation in his airspace.
    a.  Initiate ground-to-ground communications (potential low altitude situation in other controller's sector).

4.  Perceive potential low altitude situation.
    a.  Acquire target position symbol, full data block, altitude, obstruction, and minimum vector altitude on radar display for potential low altitude situation.
    b.  Acquire minimum vector altitude, prominent man-made obstacle, and highest elevation on emergency obstruction video map on radar display.
    c.  Acquire flight progress strip on flight strip bay for information indicating conditions developing into a low altitude situation.
    d.  Integrate altitude, route, obstruction/terrain, and speed information into a mental picture (with regard to potential low altitude situations).
    e.  Recognize potential low altitude situation.

5.  Determine validity of MSAW notice or indication.
    a.  Synthesize the obstruction/terrain information into a mental picture with regard to the current/projected proximity of the aircraft to obstructions/terrain.
    b.  Compare the apparent MSAW or low altitude situation with intended pilot action and/or planned control actions.
    c.  Assess the validity of the MSAW indication or low altitude notice in consideration of the mental traffic picture.

6.  Determine appropriate action to resolve low altitude situation.
    a.  Decide upon action needed to resolve low altitude situation considering mental traffic picture and available conflict resolution options.

7.  Forward notice of flight assist to supervisor.
    a.  Initiate ground-to-ground communications (valid MSAW or flight assist notice).

C.  Perform airspace conflict processing.

1.  Receive controller notice of potential/actual airspace conflict in sector.

    a.  Receive ground-to-ground communications (notice of potential aircraft-airspace conflict affecting this sector).

2.  Perceive potential/actual airspace conflict situation.
    a.  Acquire target position symbol, full data block, limited data block, and video map on radar display for potential violations of aircraft-airspace separation standards.
    b.  Acquire airspace status on the information display system or system status data record for information on special use airspace status.
    c.  Acquire flight progress strip in flight strip bay for information pertaining to possible aircraft violation of airspace separation standards.
    d.  Synthesize altitude, route, special use airspace, aircraft type, and speed information into a mental traffic picture with regard to possible violation of airspace separation standards.
    e.  Recognize potential aircraft-to-airspace conflict.

3.  Determine appropriate action to resolve airspace conflict situation.
    a.  Decide upon action needed to resolve aircraft-to-airspace conflict situation, considering mental traffic picture and available conflict resolution options.

4.  Determine validity of airspace conflict notice.
    a.  Compare airspace conflict indication with intended pilot action and/or planned control actions.
    b.  Determine validity of airspace conflict notice.

5.  Inform controller of potential airspace conflict in his sector.
    a.  Initiate ground-to-ground communications (notice to other controller of potential airspace conflict).

6.  Request release of special use airspace.
    a.  Initiate ground-to-ground communications (request for use of special use airspace).

7.  Receive denial of use of special use airspace.
    a.  Receive ground-to-ground communications (denial of request to use special use airspace).

8.  Receive approval for use of special use airspace.
    a.  Receive ground-to-ground communications (approval of request for use of special use airspace).

9.  Forward notice of potential/actual airspace conflict to supervisor.
    a.  Initiate ground-to-ground communications (airspace conflict notice).

D.  Issue unsafe condition advisories.

1.  Observe radar display for fixed obstructions/terrain that may interfere with aircraft flight.
    a.  Acquire target position symbol, full data block, (track of aircraft), obstruction, and prominent geographic feature (terrain) for obstruction interference to flight.
    b.  Synthesize altitude, route, obstruction/terrain, and aircraft type into a mental traffic picture with regard to aircraft obstruction clearance.

   c.  Recognize a potential aircraft-to-obstruction separation violation.

2. Formulate advisory/safety alert content.
   a.  Formulate contents of advisory service (advice and information to assist pilot in safe conduct of flight).
   b.  Formulate contents of safety alert (advice and information which is of a critical nature to assist pilot in safe conduct of flight).

3. Detect aircraft maneuver in response to advisory/safety alert.
   a.  Search target position symbol, full data block or limited data block, primary target or secondary target on radar display for information on aircraft responding to advisory/alert.
   b.  Detect changes in movement of target position symbol, full data block or limited data block, primary target or secondary target on radar display.
   c.  Compare aircraft movement to contents of advisory or safety alert.
   d.  Recognize pilot compliance with advisory or safety alert.

4. Issue traffic advisory/safety alert in regard to traffic proximity.
   a.  Perform air/ground communication (traffic advisory or safety alert to pilot).
   b.  Initiate ground-to-ground communications (traffic advisory or safety alert for relay to pilot).

5. Inform pilot when clear of traffic.
   a.  Perform air/ground communication (inform pilot clear of traffic).

6. Issue advisory in regard to a non-controlled airborne object/obstruction.
   a.  Perform air/ground communication (advisory to pilot in regard a non-controlled airborne object/obstruction).
   b.  Initiate ground-to-ground communications (advisory in regard to non-controlled airborne object/obstruction for relay to pilot).

7. Inform pilot when clear of non-controlled airborne object/obstruction.
   a.  Perform air/ground communication (pilot clear of non-controlled airborne object/obstruction).

8. Issue advisory in regard to airspace proximity/violation.
   a.  Perform air/ground communication (advisory to pilot in regard to restricted airspace).
   b.  Initiate ground-to-ground communications (advisory in regard to aircraft proximity to restricted airspace for relay to pilot).

9. Issue advisory in regard to flight plan deviation.
   a.  Perform air/ground communication (advisory to pilot in regard to flight plan deviation).
   b.  Initiate ground-to-ground communications (advisory in regard to flight plan deviation for relay to pilot).

10. Issue advisory/safety alert in regard to low altitude situation.
   a.  Perform air/ground communication (safety alert to pilot in regard to minimum en route/obstruction clearance altitude).

    b.  Initiate ground-to-ground communications (safety alert in regard to minimum en route/obstruction clearance altitude for relay to pilot).

11. Observe radar display for non-controlled airborne objects that may interfere with aircraft flight.
    a.  Scan target position symbol, data block, and primary target on radar display for information pertaining to aircraft/non-controlled object separation.
    b.  Detect target position symbol that is not associated with tracked targets.
    c.  Synthesize altitude, route, and position of non-controlled object(s) into a mental traffic picture relative to controlled traffic.
    d.  Recognize a non-controlled airborne object which will or may interfere with traffic flow.

12. Determine need for advisory/safety alert/clearance/control instructions.
    a.  Synthesize mental traffic picture to determine controller course of action.
    b.  Decide the appropriate course of action (advisory, safety alert, or clearance/control instruction).

E.  Suppress/restore alerts.

1. Suppress MSAW function for an aircraft.
    a.  Initiate inhibition of MSAW for specified track message.
    b.  Execute inhibition of MSAW for specified track message.
    c.  Recognize system acceptance of the inhibited MSAW for specified track message.
    d.  Initiate suppression of MSAW aural alarm message.
    e.  Execute suppression of MSAW aural alarm message.
    f.  Detect system acceptance of the suppressed MSAW aural alarm message.

2. Determine validity/appropriateness of display of an alert.
    a.  Acquire MSAW/CA alert, target position symbol, full data block, MSAW/CA alert list, and video map on radar display for potential violation of aircraft separation standards.
    b.  Acquire special activity in status information area for information pertaining to unsafe condition situation.
    c.  Acquire flight progress strip in flight strip bay for information pertaining to unsafe condition situation.
    d.  Acquire precipitation (weather return) on radar display for information pertinent to unsafe condition situation.
    e.  Acquire pertinent weather information from meteorological record.
    f.  Synthesize altitude, route, speed, and weather into a mental traffic picture.
    g.  Compare mental traffic picture with intended pilot action and/or planned control actions.
    h.  Decide if MSAW/CA alert on radar display is appropriate.

3. Restore specific alert function to normal.
    a.  Initiate enabled MSAW display message to restore to normal alert functionality.
    b.  Execute enabled MSAW display message.
    c.  Initiate restored MSAW aural alarm to restore to normal functionality.
    d.  Execute restored MSAW aural alarm message.

    e.   Detect system acceptance of alert/alarm restoration message.

4.  Receive supervisor notice to suppress alert function.
    a.   Receive ground-to-ground communications (notice to suppress an alert function).

5.  Receive supervisor notice to restore alert function.
    a.   Receive ground-to-ground communications (notice to restore an alert function to normal operation).

III. Manage air traffic sequences.

    A.  Respond to traffic management constraints/flow conflicts.

        1.  Evaluate traffic management constraints for effect on traffic flow.
            a.  Acquire target position symbol, data block, precipitation (weather returns) on radar display for information pertaining to traffic management restrictions.
            b.  Acquire expected departure clearance time and route information on departure strip pertaining to assessment of flow restrictions.
            c.  Search traffic management record for flow restriction note which could impact traffic flow.
            d.  Synthesize route, altitude, speed, and traffic management into a mental traffic picture with regard to the impact of the restrictions.
            e.  Evaluate traffic management information for effect on traffic flow.

        2.  Choose option to bring aircraft into conformance with traffic management restrictions.
            a.  Acquire aircraft positions, route, and characteristics from flight progress strip in flight strip bay.
            b.  Acquire aircraft positions and movement from full data block on radar display.
            c.  Compare traffic to traffic management constraints.
            d.  Decide to vector/reroute aircraft to bring aircraft into conformance with flow parameters.
            e.  Decide to change altitude of aircraft to bring aircraft into conformance with flow parameters.
            f.  Decide to change speed of aircraft to bring aircraft into conformance with flow parameters.
            g.  Decide to hold aircraft to bring aircraft into conformance with flow parameters.

        3.  Discuss discontinuance of traffic management restriction/traffic reroute with supervisor.
            a.  Initiate ground-to-ground communications (discuss whether flow parameters are necessary based upon current or expected traffic conditions).
            b.  Receive ground-to-ground communications (discuss whether flow restrictions are necessary based upon current or expected traffic conditions).

        4.  Review options to bring aircraft into conformance with traffic management restrictions.
            a.  Synthesize altitude and route into a mental traffic picture to decide the most appropriate action to bring an aircraft into conformance with flow parameters.
            b.  Evaluate appropriateness of vectoring/rerouting to bring aircraft into conformance with flow parameters.
            c.  Evaluate appropriateness of changing altitude to bring aircraft into conformance with flow parameters.
            d.  Evaluate appropriateness of changing speed to bring the aircraft into conformance with flow parameters.
            e.  Evaluate appropriateness of holding aircraft to bring aircraft into conformance with flow parameters.

        5.  Negotiate traffic management action with pilot.
            a.  Perform air/ground communication options (vectoring/reroute, speed adjustment, altitude adjustment, holding) to conform to traffic management restrictions.

6. Receive traffic management restriction.
   a. Receive ground-to-ground communications (traffic management restrictions).
   b. Receive notice of traffic management restriction via information display system, system status data record, or traffic management record.
   c. Receive G.I. message (traffic management restriction).

7. Receive briefing on what traffic conditions to expect.
   a. Receive ground-to-ground communications (amount of traffic, upper winds, and weather during a specific shift or time period).
   b. Synthesize information relating to expected traffic conditions.

8. Receive supervisor notice to implement traffic management restrictions.
   a. Receive ground-to-ground communications (supervisor notice of implemented traffic management restrictions).

9. Request exception to traffic management restriction.
   a. Initiate ground-to-ground communications (request traffic management exception).

10. Review traffic demands and traffic management restrictions with supervisor.
    a. Acquire flow restriction note from traffic management record.
    b. Search flight progress strip in flight strip bay for expected departure clearance time.
    c. Scan meteorological record for weather impacting traffic.
    d. Acquire precipitation on radar display impacting traffic.
    e. Initiate ground-to-ground communications (discuss traffic restrictions and traffic workload with supervisor).
    f. Receive ground-to-ground communications (traffic restrictions and traffic workload discussion from supervisor).

11. Receive approval of request for exception to flow restriction.
    a. Receive ground-to-ground communications (receive approval of traffic management restriction exception).

12. Receive denial of request for exception to flow restriction.
    a. Receive ground-to-ground communications (receive denial of traffic management restriction exception).

13. Request traffic management restriction.
    a. Initiate ground-to-ground communications (request traffic management restriction).

B. Process deviations.

1. Perceive an altitude or route deviation.
   a. Acquire target position symbol, full data block, altitude, and ground speed on radar display for violation of altitude/lateral/speed conformance.
   b. Cross-reference airway/route on video map of radar display.
   c. Acquire flight progress strip in flight strip bay for route and altitude information pertaining to potential violation of altitude or route conformance criteria.

    d.  Synthesize route, altitude, speed, and aircraft information into a mental traffic picture with regard to potential violation of altitude, speed, or route conformance criteria.

    e.  Recognize potential violation of altitude, speed, or route conformance criteria.

2.  Observe aircraft resuming flight plan conformance.

    a.  Acquire target position symbol, full data block, and altitude on radar display to determine aircraft's return to previously cleared course.

    b.  Cross-reference airway/route and NAVAID/fix on video map of radar display.

    c.  Detect changes in movement of target position symbol, full data block, altitude, and target history.

    d.  Compare aircraft location/movement with route and altitude information on flight progress strip.

    e.  Recognize aircraft responding and returning to cleared course.

3.  Determine maneuver to establish/restore flight plan conformance.

    a.  Integrate full data block, target position symbol, and flight progress strip information to determine the type of maneuver required to correct deviation.

    b.  Formulate maneuvers and instructions needed to place an aircraft within conformance limits of previously issued clearance.

4.  Evaluate flight data to assist recovery from flight plan deviation.

    a.  Acquire flight progress strip in flight strip bay for route, altitude, and speed information pertaining to nonconformance situation.

    b.  Integrate route, altitude, and aircraft information with conformance criteria to determine course of action.

    c.  Assess impact of flight data on actions to resolve an aircraft's deviation from its cleared flight plan.

5.  Evaluate unreasonable mode C indication for action needed.

    a.  Synthesize the acquired information into a mental picture with regard to the mode C unreasonableness indication.

    b.  Decide whether the problem lies with the airborne equipment or with the ATC ground interrogator equipment.

6.  Detect unreasonable mode C indication.

    a.  Scan full data block on radar display for presence of unreasonable mode C altitude indication.

    b.  Detect unreasonable mode C altitude indication in full data block on radar display.

    c.  Extract unreasonable mode C altitude from full data block.

7.  Verify altitude/altimeter setting.

    a.  Perform air/ground communication (verify altitude/altimeter setting).

8.  Inform pilot to reset altimeter/stop mode C squawk.

    a.  Perform air/ground communication (ask pilot to reset altimeter/cease mode C squawk).

9.  Receive controller notice of aircraft flight plan deviation.

    a.  Receive ground-to-ground communications (flight plan deviation).

10. Inform controller/supervisor of aircraft flight plan deviation.
   a. Initiate ground-to-ground communications (advise of flight plan deviation).

11. Receive notice to inhibit mode C for all targets.
   a. Receive ground-to-ground communications (inhibit mode C).

12. Inform supervisor of ground equipment malfunction.
   a. Initiate ground-to-ground communications (advise of interrogator malfunction).

13. Inhibit mode C for all targets.
   a. Initiate inhibition of altitude readout function.
   b. Detect removal of mode C altitude in full data block and limited data block on radar display.

C. Respond to special use airspace events.

1. Determine restrictions to users within released airspace.
   a. Integrate all available data into mental traffic picture to project effect of restrictions on all users.
   b. Determine necessary restrictions to be applied for users of released airspace.

2. Observe record of airspace status change.
   a. Search information display system or system status data record for changes in airspace status.
   b. Detect change in airspace status on information display system or system status data record.
   c. Compare new airspace information with previous information.
   d. Recognize difference between new and previous airspace data.

3. Receive notice of airspace status change.
   a. Receive ground-to-ground communications (notice of airspace status change).
   b. Perform air/ground communication (notice of airspace status change from pilot).
   c. Receive G.I. message (airspace status change).

4. Inform others on conditions of release of special use airspace.
   a. Initiate ground-to-ground communications (conditions on special use airspace release).
   b. Perform air/ground communication (conditions on special use airspace release).

5. Inform others of airspace status change.
   a. Initiate ground-to-ground communications (airspace status change).
   b. Perform air/ground communication (airspace status change).

6. Receive request for use of special use airspace.
   a. Receive ground-to-ground communications (special use airspace use request).
   b. Perform air/ground communication (special use airspace use request).

D. Establish arrival sequences.

1. Determine descent time or point.

a. Acquire target position symbol, full data block, limited data block, and precipitation on radar display for information applicable to establishing arrival patterns.
b. Cross-reference NAVAID/fix and/or arrival gate in video map on radar display.
c. Extract flow restriction note information from traffic management record for pertinent flow constraints.
d. Synthesize altitude, route, speed, and flow restrictions into a mental traffic picture with regard to establishing arrival patterns.
e. Decide descent time or point for each aircraft.

2. Project traffic sequence to establish/modify approach flow to airport or sector.
   a. Identify aircraft landing at specified airport based on full data block, flight progress strip, and arrival/departure list.
   b. Synthesize acquired destination information into mental picture of arrival flow of aircraft in or near terminal area.

3. Project mentally the range/bearing between aircraft.
   a. Acquire target position symbol, full data block, range mark, compass rose on radar display for information pertaining to range/bearing between aircraft. b. Extrapolate the range and bearing between aircraft from information on radar display.

4. Project mentally the arrival flow for aircraft landing in or near this sector.
   a. Recognize aircraft landing in or near the terminal area.
   b. Synthesize acquired destination information into mental picture of arrival flow of aircraft in or near terminal area.

5. Issue current arrival information.
   a. Extract ATIS message, weather information, airport status (as required) from information display system or system status data record and meteorological record.
   b. Perform air/ground communication (issue arrival information).

6. Observe radar target/data block of arrival aircraft.
   a. Scan target position symbol, full data block, partial data block, primary target, secondary target on radar display.
   b. Detect aircraft identification and target position symbol in full data block of aircraft entering pattern.
   c. Perceive aircraft position/location in reference to other traffic.

7. Verify pilot has current arrival information.
   a. Perform air/ground communication (confirm pilot has current arrival information).

8. Receive pilot request for ARSA/TRSA/TCA operations.
   a. Perform air/ground communication (pilot request for ARSA/TRSA/TCA operation).

9. Determine approach sequence.
   a. Compare approach aircraft types and flight characteristics in relation to available runways.
   b. Decide approach aircraft sequence and spacing in regard to altitude requirements.

10. Request aircraft be rerouted.

    a. Initiate ground-to-ground communications (aircraft rerouting request).

11. Receive flight progress strip/record on arrival aircraft.
    a. Acquire arrival strip (or paper recording) on arrival aircraft from FDIO system, flight strip printer, or other controller.

12. Record necessary flight plan data.
    a. Execute record flight strip entry to write necessary flight plan data on strip or paper record.

13. Forward arrival sequence to tower controller.
    a. Initiate ground-to-ground communications (inform of arrival sequence).

E. Manage departure flows.

1. Validate mode C altitude.
    a. Search full data block on radar display for information related to aircraft mode C altitude.
    b. Extract mode C altitude from full data block on the radar display (aircraft's current altitude).
    c. Compare mode C altitude and assigned altitude with pilot-reported altitude.
    d. Decide the validity of mode C altitude displayed for aircraft.

2. Enter reported altitude.
    a. Initiate entry of scratch pad/altitude message to enter a pilot-reported altitude in a full data block.
    b. Execute entry of scratch pad/altitude message.
    c. Detect appearance of pilot-reported altitude information in full data block on radar display.

3. Project traffic sequence to establish/modify departure flow.
    a. Recognize aircraft departing in or through this sector based on departure airport and proposed departure time or expect departure clearance time on flight progress strip in FS bay.
    b. Recognize aircraft departing in or through this sector by matching aircraft identification in flight progress strip and aircraft identification in departure list on radar display.
    c. Synthesize extracted information into a mental picture of departure flow in relation to the overall mental traffic picture.
    d. Project traffic sequence to establish/modify departure flow based on mental traffic picture.

4. Receive notice of missed approach.
    a. Perform air/ground communication (pilot notice of missed approach).
    b. Receive ground-to-ground communications (tower notice of missed approach).

5. Receive request for release of departure aircraft from tower.
    a. Receive ground-to-ground communications (tower request for release of departure aircraft).

6. Forward departure release.
   a. Initiate ground-to-ground communications (inform tower of departure release for aircraft).

7. Record assigned altitude on flight progress strip.
   a. Execute record flight strip entry to write assigned altitude on flight progress strip.

F. Monitor non-controlled airborne objects.

1. Observe airspace intrusion by a non-controlled airborne object.
   a. Scan target position symbol and data block on radar display for possible non-controlled airborne object.
   b. Detect target position symbol, primary target not associated with data block (non-controlled airborne object).

2. Flight-follow an observed non-controlled airborne object.
   a. Initiate start track message to start a track/flight follow non-controlled airborne object.
   b. Execute start track message.
   c. Initiate start track file message to start a track/flight follow non-controlled airborne object.
   d. Execute start track file message.
   e. Detect full data block on the radar display (non-controlled airborne object becomes a tracked data block).
   f. Assess track movement of non-controlled airborne object.

3. Record controller note.
   a. Execute recording of controller note for reminder information.

4. Forward notice of airspace intrusion by a non-controlled airborne object.
   a. Initiate ground-to-ground communications (airspace intrusion by a non-controlled airborne object).

5. Receive notice of airspace intrusion by a non-controlled airborne object.
   a. Receive ground-to-ground communications (airspace intrusion by non-controlled airborne object).

G. Respond to temporary release of airspace requests.

1. Discuss release of airspace for temporary use.
   a. Initiate ground-to-ground communications (release of airspace for temporary use).
   b. Receive ground-to-ground communications (release of airspace for temporary use).
   c. Evaluate merits of equipment release.

2. Select map display of adapted airspace requested for use by another controller.
   a. Execute selection of map function to display airspace boundary on video map of temporary use airspace requested.
   b. Detect appearance of airspace boundary (airspace) on video map of radar display.

3. Evaluate feasibility of releasing airspace temporarily.
   a. Acquire target position symbol, data block, and airspace boundary on radar display for information pertaining to temporarily releasing airspace.
   b. Extract airspace status from information display system or system status data record for current/projected airspace usage/availability.
   c. Acquire flight progress strip on flight strip bay for information pertaining to current/projected airspace usage/availability.
   d. Synthesize route, altitude, airspace availability, and other information into a mental traffic picture with regard to approving temporary use of airspace.
   e. Decide feasibility of temporarily releasing airspace to another controller.

4. Receive request for temporary use of airspace.
   a. Initiate ground-to-ground communications (airspace release request).

5. Forward approval for temporary use of airspace.
   a. Receive ground-to-ground communications (approval of airspace release).

6. Forward denial of temporary use of airspace.
   a. Receive ground-to-ground communications (denial of airspace release).

7. Receive notification of return of released airspace.
   a. Receive ground-to-ground communications (airspace returned).

H. Request temporary release of airspace.

1. Request temporary use of airspace.
   a. Initiate ground-to-ground communications (temporary use of airspace).

2. Receive release/use of airspace.
   a. Receive ground-to-ground communications (airspace release).

3. Receive rejection of use of airspace.
   a. Receive ground-to-ground communications (denial of airspace usage).

4. Forward notice of return of released airspace.
   a. Initiate ground-to-ground communications (airspace returned).

IV. Route or plan flights.

A. Plan clearances.

   1. Review potential impediments for impact on proposed clearance.
     a. Acquire target position symbol, data block, obstruction, and precipitation (weather return) on radar display for information pertaining to impact on proposed clearance.
     b. Acquire flight progress strip in flight strip bay for information pertaining to factors which will impact proposed clearance.
     c. Acquire pertinent flow restriction information from traffic management record.
     d. Extract weather information from meteorological record which may impact proposed clearance.
     e. Synthesize altitude, route, weather, speed, and destination into a mental traffic picture with regard to factors which will impact proposed clearance.
     f. Recognize factors which will impact proposed clearance.

   2. Discuss clearance alternatives with pilot.
     a. Perform air/ground communication (discuss course of action suitable for traffic demands with pilot).

   3. Determine priority of control actions.
     a. Decide the order in which control actions need to be implemented.

   4. Perceive need for amended clearance.
     a. Acquire target position symbol, data block, and precipitation (weather return) on radar display for information pertaining to need for amended clearance.
     b. Acquire flight progress strip in flight strip bay for information pertaining to need for amended clearance.
     c. Extract pertinent flow restrictions from traffic management record.
     d. Acquire weather information from meteorological record affecting proposed clearance.
     e. Synthesize altitude, route, and weather into a mental traffic picture with regard to need to amend clearance of one or more aircraft.
     f. Compare mental traffic picture with pilot's intentions and/or planned control actions.
     g. Recognize need to amend aircraft clearance.

   5. Formulate plan of action for clearance generation.
     a. Decide the requirements and restrictions necessary for composing a clearance based on available information.

   6. Determine appropriate action for aircraft clearance.
     a. Synthesize mental traffic picture to determine controller course of action.
     b. Decide the appropriate course of action for controller generated clearance.

   7. Receive notice on requested clearance of aircraft leaving other controller's sector.
     a. Receive ground-to-ground communications (notice on aircraft clearance).

   8. Receive pilot's clearance request directly or as relayed.
     a. Perform air/ground communication (pilot's clearance request).
     b. Receive ground-to-ground communications (pilot's relayed clearance request).

9. Receive controller request for clearance/approval.
   a. Receive ground-to-ground communications (request for clearance/approval).

10. Forward clearance request to another controller.
    a. Initiate ground-to-ground communications (forward clearance request).

11. Request clearance/approval from another controller.
    a. Initiate ground-to-ground communications (request clearance).

12. Receive clearance approval/clearance restrictions from another controller.
    a. Receive ground-to-ground communications (clearance approval/clearance restrictions).

13. Receive clearance disapproval/denial from another controller.
    a. Receive ground-to-ground communications (clearance disapproval).

14. Receive alternate suggestion for clearance/approval requested of another controller.
    a. Receive ground-to-ground communications (alternate clearance suggestions).

15. Evaluate flight progress strip changes for clearance planning or future actions.
    a. Analyze flight progress strip for changes in clearance and check for completeness of clearance.
    b. Evaluate clearance changes.
    c. Decide impact of clearance changes on other traffic.

B. Respond to contingencies/emergencies.

1. Issue instructions to pilot (NORDO) for identification turn/transponder response.
   a. Perform air/ground communication (issue instructions to aircraft with no transmitter).

2. Detect a pilot or aircraft problem (e.g., hypoxia, exception beacon code).
   a. Scan full data block on radar display for possible aircraft problem.
   b. Detect unreasonable mode C altitude, radio failure beacon code or other indication of possible aircraft problem.
   c. Perform air/ground communication (detect erratic or abnormal pilot communication behavior).
   d. Integrate data received to make a decision as to whether a potential problem exists.

3. Observe aircraft turn/transponder response following identification request.
   a. Search target position symbol, data block on radar display for aircraft turn or transponder in response to instructions issued by an ATC facility.
   b. Recognize movement of target position symbol, full data block, primary target, secondary target, and target history on radar display in response to instructions issued.
   c. Detect appropriate beacon code in full data block of the aircraft in question.
   d. Detect appropriate "ident" indication in full data block of aircraft in question.

4. Conduct radio/radar search for overdue aircraft.
   a. Decide appropriate course of action for search.

    b.  Scan target position symbol, data block, target history, ident return on radar display (transponder code change, ident, or change of heading in response to ATC clearance).

    c.  Perform air/ground communication (attempting to contact overdue aircraft or requesting another aircraft to attempt to contact the overdue aircraft).

    d.  Initiate ground-to-ground communications (instructing a flight service station to attempt to contact an overdue aircraft).

    e.  Ensure guard air/ground communications (monitor emergency frequencies).

5.  Receive supervisor notice to conduct communications search for overdue/NORDO aircraft.

    a.  Receive ground-to-ground communications (notice from supervisor to conduct communications search for overdue aircraft).

6.  Receive notice that supervisor will conduct communications search for overdue/NORDO aircraft.

    a.  Receive ground-to-ground communications (notice that supervisor will conduct a communications search for overdue aircraft).

7.  Receive pilot notice of emergency declared.

    a.  Perform air/ground communication (pilot declares emergency).

    b.  Scan full data block and limited data block on radar display for emergency beacon code or hijack beacon code (indicating aircraft emergency).

    c.  Detect emergency beacon code or hijack beacon code in full data block or limited data block.

8.  Declare emergency and invoke contingency plan.

    a.  Cross-reference checklist (emergency), position binder, and emergency procedure binder in static information record.

    b.  Initiate ground-to-ground communications (notify others of emergency and contingency plan).

9.  Receive notice of pilot or aircraft having a problem (e.g., overdue, loss of radio contact).

    a.  Perform air/ground communication (pilot/aircraft problem).

    b.  Receive ground-to-ground communications (pilot/aircraft problem).

10. Forward contingency/emergency information to others.

    a.  Initiate ground-to-ground communications (relay emergency/contingency information).

11. Inform designated personnel of aircraft having flight problems.

    a.  Initiate ground-to-ground communications (aircraft having problems).

12. Request relay of instructions to pilot (NORDO) for identification turn/transponder response.

    a.  Initiate ground-to-ground communications (request relay of instructions to pilot of NORDO aircraft).

    b.  Perform air/ground communication (request relay of instructions by another pilot to pilot of NORDO aircraft).

13. Conduct search for aircraft without radio contact.

    a. Cross-reference no radio options in checklist, position binder, and emergency procedure binder.
    b. Decide on possible options to contact aircraft.
    c. Perform air/ground communication (broadcast "in the blind" in attempt to contact pilot).
    d. Initiate ground-to-ground communications (attempt contact through another controller).

14. Review contingency checklist on static record.
    a. Cross-reference checklist, position binder, and emergency position binder in static information binder.

15. Receive supervisor notice of emergency declared and contingency plan invoked.
    a. Initiate ground-to-ground communications (notify supervisor of contingency/emergency).

C. Respond to special operations.

1. Perceive presence of special operation.
    a. Acquire full data block on radar display for special operations aircraft (special aircraft callsign which alerts controller to use special procedures).
    b. Detect full data block in special use airspace on radar display.
    c. Acquire flight progress strip in flight strip bay for indication of special operations aircraft (callsign, special handling remarks, etc.).
    d. Acquire airspace status, special activity on information display system or system status data record.
    e. Recognize full data block associated with special operation.

2. Receive review/notice of special operation.
    a. Receive G.I. message (notice of special operation).
    b. Receive special activity in status information area.
    c. Perform air/ground communication (information on special operation from pilot).
    d. Receive ground-to-ground communications (receive information on special operation).

3. Forward notice of special operations to another controller/supervisor.
    a. Send G.I. message (notice of special operation).
    b. Initiate ground-to-ground communications (notifying other personnel of special operation).

4. Conduct special operation actions.
    a. Cross-reference checklist, position binder, and letter of agreement in static information record.
    b. Decide actions required for the special operation.

5. Receive notice of termination of special operation.
    a. Receive ground-to-ground communications (special operation termination).
    b. Receive G.I. message (termination of special operation).

D. Review flight plans.

1. Observe new flight progress strip.
   a. Detect flight progress strip in flight strip bay or flight strip printer (new flight data).

2. Review flight plan for completeness.
   a. Evaluate flight progress strip for completeness.
   b. Decide what data are missing from flight progress strip (after scanning each field to determine if necessary information is available).

3. Review flight progress strip for errors/posting sequence.
   a. Search flight progress strip in flight strip bay for errors and appropriate sequence in the bay.
   b. Assess correctness of information in flight progress strip.
   c. Decide what data are incorrect in flight progress strip (after scanning each field to determine correctness of information).
   d. Decide if flight progress strip is in the proper position in the flight strip bay.

4. Receive flight plan from pilot.
   a. Perform air/ground communication (receive flight plan from pilot).

5. Receive flight plan verbally forwarded.
   a. Receive ground-to-ground communications (receiving flight plan information).

6. Query pilot about flight plan.
   a. Perform air/ground communication (question pilot regarding filed flight plan).

7. Forward flight plan verbally.
   a. Initiate ground-to-ground communications (flight plan information).

8. Enter scratch pad data in full data block.
   a. Initiate entry of scratch pad message.
   b. Execute entry of scratch pad message.
   c. Detect system acceptance of entered scratch pad message (entry in full data block).

9. Record new flight plan on flight progress strip.
   a. Execute recording of flight strip entry to write new flight plan on blank flight progress strip.

10. Query the relayer of a flight plan.
    a. Initiate ground-to-ground communications (flight plan query).
    b. Receive ground-to-ground communications (response to flight plan query).

11. Inform pilot/relayer of required flight plan changes.
    a. Perform air/ground communication (required flight plan changes to pilot).
    b. Initiate ground-to-ground communications (required flight plan changes conveyed to other controllers, flight service).

12. Enter flight information in ARTS.
    a. Initiate flight data function.
    b. Execute flight data function.

    c. Initiate flight data function abbreviated.
    d. Execute flight data function abbreviated.
    e. Detect system acceptance of ARTS entry of flight information.

13. Enter flight plan in FDIO.
    a. Initiate entry of proposed/active flight plan to enter flight plan into FDIO system.
    b. Execute entry of proposed/active flight plan message.
    c. Initiate entry of stereo flight plan to enter stereo flight plan into FDIO system.
    d. Execute entry of stereo flight plan message.

E. Process flight plan amendments.

1. Receive flight data revision.
    a. Receive new flight progress strip (replacing previous strip in flight strip bay) from flight strip printer of FDIO system.
    b. Receive new flight progress strip transmitted by other individual in approach control room.
    c. Extract new flight progress strip in flight strip bay for flight data revisions.
    d. Compare new data in flight progress strip with previous flight data information to note nature of the change.

2. Enter flight plan amendment.
    a. Initiate flight plan amendment on FDIO system (AM message for amending system flight plan data on an aircraft).
    b. Execute flight plan amendment message.

3. Receive flight plan amendment verbally forwarded.
    a. Receive ground-to-ground communications (receive flight plan amendment).

4. Receive pilot's position report.
    a. Perform air/ground communication (receive position report from pilot).

5. Discuss flight plan amendment.
    a. Initiate ground-to-ground communications (discuss flight plan amendment with other controller or facility).
    b. Receive ground-to-ground communications (discussion of flight plan amendment from other controller or facility).

6. Flag flight progress strip for reminder action.
    a. Execute flagging of flight progress strip for reminder action.

7. Unflag flight progress strip.
    a. Execute unflagging of flight progress strip to delete reminder for control action.

8. Inform requestor of unable flight plan amendment.
    a. Perform air/ground communication (inform pilot that flight plan amendment request is not possible).
    b. Initiate ground-to-ground communications (inform non-pilot requestor of flight plan amendment that the request is not possible).

9. Receive controller advice of unable flight plan amendment.
   a. Receive ground-to-ground communications (unable requested flight plan amendment).

10. Forward request for flight plan amendment to other controller.
    a. Initiate ground-to-ground communications (request for flight plan amendment).

11. Receive pilot request for flight plan amendment.
    a. Perform air/ground communication (pilot request for flight plan amendment).

12. Determine need for flight plan amendment.
    a. Synthesize mental traffic picture, weather conditions, routing availability, and other conditions influencing possible need for amending a flight's flight plan.
    b. Assess flight path of aircraft.
    c. Assess application of preferential route.
    d. Assess traffic management restrictions.
    e. Decide need for flight plan amendment.

13. Query pilot/controller on flight plan amendment.
    a. Perform air/ground communication (query pilot on flight plan amendment).
    b. Initiate ground-to-ground communications (query other controller or facility on flight plan amendment).
    c. Receive ground-to-ground communications (response to query on flight plan amendment).

14. Record flight plan amendment on flight progress strip.
    a. Execute recording flight strip entry to write flight plan amendment on flight progress strip.

15. Forward pilot's position report.
    a. Initiate ground-to-ground communications (position report from pilot).

16. Forward flight plan amendment verbally.
    a. Initiate ground-to-ground communications (flight plan amendment).

17. Review flight plan amendment for accuracy.
    a. Compare content of flight plan amendment with required flight plan contents.
    b. Decide proposed flight plan amendment is correct.

F. Receive transfer of control/radar identification.

   1. Accept verbal handoff/initiate manual track start/quick look.
      a. Receive ground-to-ground communications (accepting verbal handoff).
      b. Initiate start track message.
      c. Execute start track message.
      d. Initiate activation of quick look button to force radar data from adjacent airspace to radar display.
      e. Execute activation of quick look button message.

    f. Detect target position symbol and associated full data block on radar display (results of track start message).

    g. Extract full data block (quick look) on radar display from another sector.

2. Accept automatic handoff.
    a. Initiate accepting handoff message for acceptance of handoff.
    b. Execute accepting handoff message.
    c. Detect acceptance of handoff by change in control position symbol and change of blinking FDB to steady full data block on radar display.
    d. Initiate ground-to-ground communications (accept handoff).

3. Determine that aircraft is entering sector.
    a. Acquire full data block, sector/center boundary, position boundary in video map on radar display for information to determine if aircraft is entering sector.
    b. Search flight progress strip in flight strip bay for flight data on aircraft potentially entering sector.
    c. Synthesize flight data information into a mental picture of aircraft position.
    d. Recognize aircraft is entering sector airspace.

4. Determine response to handoff request.
    a. Search target position symbol, full data block on radar display to determine response to handoff request.
    b. Search flight progress strip in flight strip bay for information concerning whether or not to accept handoff.
    c. Synthesize altitude, speed, and route into a mental traffic picture with regard to accepting handoff.
    d. Decide whether or not to accept handoff based on mental traffic picture.

5. Request transfer of control.
    a. Initiate ground-to-ground communications (action to request control of aircraft).

6. Deny handoff.
    a. Initiate ground-to-ground communications (deny handoff).

7. Receive control of aircraft.
    a. Receive ground-to-ground communications (transfer of aircraft control).

G. Initiate transfer of control/radar identification.

1. Initiate handoff.
    a. Initiate handoff message to start handoff action to another sector or facility.
    b. Execute initiation of handoff message.
    c. Detect system acceptance of initiated handoff message by handoff symbol in full data block on radar display.
    d. Detect acceptance of the initiated handoff message by observing the removal of the handoff symbol in full data block on radar display.
    e. Initiate ground-to-ground communications (initiate handoff).

2. Retract handoff.

    a. Initiate retraction of handoff message to recall a previously initiated handoff.
    b. Execute retraction of handoff message.
    c. Detect system acceptance of the retracted handoff message by observing the removal of handoff symbol in full data block on radar display.
    d. Initiate ground-to-ground communications (retract handoff).

3. Receive handoff acceptance.
    a. Search for handoff symbol in the full data block on radar display.
    b. Recognize handoff symbol (flashing) in the full data block indicating handoff was accepted.
    c. Recognize subsequent disappearance of full data block.
    d. Receive ground-to-ground communications (handoff acceptance).

4. Discuss transfer of control with other controller.
    a. Initiate ground-to-ground communications (forward information concerning transfer of control of an aircraft).
    b. Receive ground-to-ground communications (information on transfer of control).

5. Receive request for transfer of control.
    a. Receive ground-to-ground communications (receive request for transfer of control of aircraft).

6. Determine that aircraft is leaving sector.
    a. Acquire sector/center boundary, position boundary, target position symbol, full data block on radar display for information to determine if aircraft is leaving sector.
    b. Search flight progress strip in flight strip bay (for information of aircraft potentially leaving sector).
    c. Synthesize last known position and movement of full data block on radar display into a mental picture of aircraft position.
    d. Project mental picture of aircraft position with respect to location of sector boundary.
    e. Recognize aircraft is leaving sector airspace.

7. Receive handoff rejection.
    a. Receive ground-to-ground communications (handoff rejection).

8. Redirect handoff.
    a. Initiate ground-to-ground communications (redirect handoff).

9. Inform controller of relinquished control of aircraft.
    a. Initiate ground-to-ground communications (control relinquished).

10. Inform controller of any conditions affecting transfer of control.
    a. Initiate ground-to-ground communications (discuss conditions affecting handoff).

H. Issue pointouts.

1. Discuss pointout with other controller.
    a. Initiate ground-to-ground communications (informing controller regarding a pointout).
    b. Receive ground-to-ground communications (discuss pointout).

2. Initiate pointout.
   a. Initiate ground-to-ground communications (initiate pointout).

3. Forward flight plan data to another controller.
   a. Initiate ground-to-ground communications (forward flight plan).

4. Receive acceptance of pointout.
   a. Receive ground-to-ground communications (pointout acceptance).

5. Receive rejection of pointout.
   a. Receive ground-to-ground communications (pointout rejection).

I. Respond to pointouts.

1. Suppress full data block after pointout.
   a. Initiate erasure of FDB readout message.
   b. Execute erasure of FDB readout message.
   c. Recognize removal of full data block from radar display.

2. Determine response to pointout.
   a. Acquire target position symbols, full data block, precipitation on radar display to determine necessity to accept/reject pointout.
   b. Acquire flight progress strip in flight strip bay to determine action required regarding pointout.
   c. Synthesize altitude, route, aircraft and speed information into a mental picture with regard to pointout.
   d. Decide appropriate response to pointout.

3. Receive pointout request.
   a. Receive ground-to-ground communications (pointout request).

4. Accept pointout/initiate manual track start/quick look.
   a. Initiate ground-to-ground communications (accept pointout).
   b. Initiate start track message.
   c. Execute start track message.
   d. Detect track activation by observing full data block, target position symbol, primary target or secondary target on radar display.
   e. Initiate activation of quick look button function.
   f. Detect full data block, partial data block, primary target, and secondary target on radar display.

5. Deny pointout.
   a. Initiate ground-to-ground communications (deny pointout).

J. Issue clearances.

1. Suggest clearance alternatives to pilot.
   a. Perform air/ground communication (clearance alternative to pilot).

2. Formulate a clearance with appropriate instructions.
   a. Acquire target position symbol, full data block, precipitation (weather return), published approach/departure procedure on radar display pertinent to clearance formulation.
   b. Acquire NAVAID/fix, airway/route, and arrival/departure gate on radar display for information pertaining to clearance formulation.
   c. Synthesize altitude, route, fix, gate, and weather information into a mental traffic picture with regard to formulating a clearance.
   d. Formulate a clearance with appropriate instructions to provide required separation.

3. Issue clearance and instructions to pilot.
   a. Cross-reference flight progress strip for planned actions and instructions.
   b. Perform air/ground communication (current clearance and instructions).
   c. Communicate with aircraft at uncontrolled airports (need clearance void time and departure instructions).

4. Detect readback of issued clearance.
   a. Detect whether readback of issued clearance is correct.
   b. Transmit clearance until readback is correct.

5. Verify aircraft compliance with clearance.
   a. Acquire target position symbol, full data block, primary target or secondary target on radar display for information pertaining to clearance compliance.
   b. Cross-reference airway/route, arrival/departure gate, and NAVAID/fix on radar display for information pertaining to clearance compliance.
   c. Synthesize altitude, route, and departure/arrival information into a mental traffic picture with respect to aircraft compliance with clearance instructions.
   d. Decide if aircraft is in compliance with clearance instructions as issued by ATC.

6. Query pilot regarding compliance with clearance.
   a. Perform air/ground communication (clearance non-compliance query and response).

7. Approve clearance request.
   a. Initiate ground-to-ground communications (clearance request approval).

8. Issue clearance to others for relay to pilot.
   a. Initiate ground-to-ground communications (pass clearance for relay).

9. Deny clearance request.
   a. Initiate ground-to-ground communications (clearance request denial).
   b. Initiate ground-to-ground communications (deny clearance request).

10. Suggest alternatives to clearance request from controller.
    a. Initiate ground-to-ground communications (clearance request alternatives).

K. Establish, maintain, and terminate radio communications.

1. Receive request to cancel air traffic services.

    a. Perform air/ground communication (request from pilot to cancel air traffic services).

2. Terminate radio communications with aircraft.
    a. Perform air/ground communication (advising a pilot to change to another frequency or that a listening watch is no longer required on assigned frequency).

3. Receive arrival message.
    a. Receive ground-to-ground communications (FSS notice of arrival time).
    b. Perform air/ground communication (notice from pilot of arrival time at destination airport).

4. Determine frequency in use by receiving sector.
    a. Search information display system or system status data record for frequency in use by sector.
    b. Search NAVAID/radio frequency list or overhead map in static information record for frequency in use.
    c. Extract assigned frequency from system status data display, information display system, and NAVAID/radio frequency list or overhead map.

5. Issue change of frequency to pilot.
    a. Perform air/ground communication (issuing a frequency change to an aircraft).

6. Receive initial radio contact from pilot.
    a. Perform air/ground communication (initial call from pilot reporting his presence on frequency).

7. Verify aircraft has proper ATIS code.
    a. Advise pilot of new ATIS code.
    b. Verify pilot receives new ATIS code.

8. Issue altimeter setting.
    a. Extract altimeter setting from altimeter setting indicator or digital altimeter setting indicator on airport environmental instrument.
    b. Extract altimeter setting from system data area on radar display.
    c. Perform air/ground communication (issuing altimeter to a pilot along route or at destination).

9. Verify aircraft altitude.
    a. Search full data block on radar display for aircraft in question.
    b. Extract aircraft identification and mode C altitude in full data block on radar display for aircraft in question.
    c. Search flight progress strip in flight strip bay for altitude of aircraft in question.
    d. Extract altitude or requested altitude from arrival strip, departure strip, or overflight strip for aircraft in question.
    e. Perform air/ground communication (request for pilot report of altitude of aircraft).
    f. Compare pilot altitude with system reported altitude.

10. Issue change to VFR beacon code assignment.
    a. Perform air/ground communication (change beacon code).

11. Drop flight plan and track from ATC system.
    a. Initiate drop of flight plan message (FDIO) for desired aircraft.
    b. Execute drop of flight plan message.
    c. Initiate drop of track (ARTS) message for desired track.
    d. Execute drop of track message.

L. Establish, reestablish radar identification.

1. Observe target entering radar coverage.
    a. Acquire target position symbol and full data block from radar display.
    b. Extract position boundary or sector-center boundary on video map on radar display.
    c. Detect appearance of new full data block on radar display.
    d. Detect primary target not associated with full data block or target position symbol on radar symbol.
    e. Detect limited data block for target position symbol as target entering radar coverage.

2. Inform pilot that radar contact is established.
    a. Perform air/ground communication (advising pilot that radar contact has been established).

3. Observe radar target on departing aircraft within one mile of takeoff runway.
    a. Detect primary target, secondary target, target position symbol, and full data block on radar display.
    b. Cross-reference runway centerline extension and/or departing airport/heliport on in video map on radar display.

4. Observe beacon target change to specified code.
    a. Acquire limited data block on radar display.
    b. Detect limited data block on radar display of aircraft of interest.

5. Observe correct beacon code.
    a. Turn on transponder if no beacon code is observed.
    b. Check for compliance.

6. Observe transponder not functioning.
    a. Turn off transponder.
    b. Manually start data block and tracking.

7. Observe radar target corresponding to target associated with handoff.
    a. Acquire target position symbol, full data block, limited data block, primary target, and secondary target on radar display.
    b. Cross-reference sector/center boundary and position boundary on video map on radar display.
    c. Detect aircraft identification, blinking FDB, and target position symbol on radar display corresponding to aircraft being handed off.

8. Inform pilot to make identifying turn (30 or more degrees).
    a. Perform air/ground communication (request turn for identification).

9. Observe radar target corresponding to identifying turn requested.
   a. Acquire target position symbol, full data block, primary target, and secondary target on radar display.
   b. Detect full data block, target position symbol, and target history on radar display making requested turn.

10. Request pilot squawk ident.
    a. Perform air/ground communication (request pilot ident).

11. Observe target bloom, double slash, or data block ident.
    a. Detect ident return, aircraft identification in full data block on radar display.

12. Request pilot change transponder to standby.
    a. Perform air/ground communication (request pilot change to beacon standby mode).

13. Observe loss of beacon target.
    a. Detect loss of secondary target on radar display.

14. Request pilot to return transponder to normal.
    a. Perform air/ground communication (request pilot to return to normal beacon mode).

15. Observe reappearance of beacon target.
    a. Detect appearance of secondary target on radar display.

16. Inform pilot of radar position.
    a. Perform air/ground communication (inform pilot of radar position).

17. Observe radar target corresponding to pilot report.
    a. Acquire target position symbol, full data block, limited data block, primary target, and secondary target on radar display.
    b. Extract aircraft identification in full data block or limited data block corresponding to pilot reported position.
    c. Extract primary target or secondary target on radar display corresponding to pilot reported position.

18. Request/assign beacon code to aircraft.
    a. Initiate start track file, flight data function abbreviated, or flight data function to obtain beacon code.
    b. Execute start track file, flight data function abbreviated, or flight data function.
    c. Extract beacon code in readout area on radar display.
    d. Perform air/ground communication (issue beacon code to pilot).

19. Receive handoff request.
    a. Detect blinking FDB on radar display indicating handoff request.
    b. Receive ground-to-ground communications (handoff request).

V. Assess weather impact.

   A. Respond to significant weather information.

      1. Receive weather briefing.
        a. Receive ground-to-ground communications (weather briefing).
        b. Receive G.I.message (weather information).

      2. Determine whether another controller or pilot needs weather advisory.
        a. Assess impact of weather on pilots or controllers and the need to forward a weather advisory to pilot or other controller.
        b. Decide whether or not to issue weather advisory.

      3. Receive weather advisory.
        a. Receive ground-to-ground communications (weather advisory).
        b. Receive G.I. message (weather advisory).
        c. Detect weather advisory on information display system or meteorological record.

      4. Broadcast weather information.
        a. Perform air/ground communication (weather information).

      5. Observe radar display of weather line/intensity/movement.
        a. Acquire precipitation (weather return) on radar display for actual weather precipitation conditions.
        b. Synthesize acquired weather information into a mental weather picture.
        c. Assess severity of weather conditions.
        d. Estimate the dimensions and movement of the weather if such data are not available.

      6. Determine weather impact on routes/flow.
        a. Integrate weather information with current/projected traffic to form a mental picture of weather and impact on traffic.
        b. Assess the impact of known and forecast weather on traffic flows and routes.
        c. Reroute traffic if weather is a factor.
        d. Assess impact of weather on adjacent sectors/positions.
        e. Assess impact of weather on adjacent facilities.

      7. Determine altitude/route change to bypass severe weather.
        a. Integrate weather information with mental traffic picture.
        b. Decide altitudes/routes to bypass severe weather based on mental traffic and weather picture and routes through area.

      8. Evaluate impact of new weather condition.
        a. Acquire new weather conditions/reports from radar display, information display system, meteorological record, and airport environmental instrument which may affect workload.
        b. Synthesize new weather conditions and pilot requests for altitude change or reroute into a mental weather picture.
        c. Compare new mental weather picture with mental traffic picture.
        d. Evaluate new weather conditions and its impact on traffic in adjacent sectors/positions.

e. Evaluate new weather conditions and its impact on traffic in adjacent facilities.

9. Receive PIREP on weather.
   a. Perform air/ground communication (PIREP).
   b. Receive ground-to-ground communications (PIREP relayed by others).

10. Receive new routing for weather avoidance.
    a. Receive ground-to-ground communications (new routing for weather avoidance).
    b. Receive G.I. message (new routing for weather avoidance).

11. Record PIREP.
    a. Execute recording PIREP to document PIREP information.

12. Issue weather/advisory/update to others.
    a. Initiate ground-to-ground communications (weather/advisory/update).
    b. Perform air/ground communication (weather/advisory/update to pilot).

13. Inform supervisor of weather impact on routes/flow.
    a. Initiate ground-to-ground communications (weather impact on routes/flow).

14. Receive controller request for weather information.
    a. Receive ground-to-ground communications (weather information).

15. Forward weather information to supervisor.
    a. Initiate ground-to-ground communications (weather information).

16. Observe record of new/changed meteorological data.
    a. Acquire new/changed weather information on meteorological record or information display system.
    b. Receive G.I. message (new/changed weather information).

17. Forward airport environmental data.
    a. Initiate ground-to-ground communications (airport environmental information).

18. Forward urgent PIREP to others.
    a. Initiate ground-to-ground communications (urgent PIREP).
    b. Perform air/ground communication (urgent PIREP).

19. Request weather information.
    a. Initiate ground-to-ground communications (weather request).
    b. Perform air/ground communication (weather request).
    c. Receive weather information from aircraft via air/ground.

B. Process weather reports.

1. Receive weather report/update (e.g., hourly surface observation, IDS).
   a. Acquire weather reports via meteorological record and/or information display system.
   b. Receive ground-to-ground communications (weather report update, e.g., hourly surface observation, etc.).

   c. Receive weather information via G.I. message on flight strip printer on FDIO system.

2. Determine whether control zone is IFR/VFR.
   a. Acquire airport environmental instrument data for visibility/ceiling information to determine whether airport is IFR or VFR.
   b. Search surface observation, terminal forecast, domestic area forecast in meteorological record for data to determine is IFR or VFR conditions exist.
   c. Synthesize weather information into mental weather picture (compare actual weather conditions with published IFR minimums).
   d. Decide if control zone is IFR or VFR.

3. Review ATIS voice recording.
   a. Review ATIS message on information display system or system status data record for weather information.
   b. Monitor ATIS voice recording (review weather information).
   c. Assess ATIS information and possible impact on traffic or terminal operations.

4. Forward runway use data.
   a. Initiate ground-to-ground communications (runway use data).
   b. Communicate ground-to-ground (runway use data).
   c. Perform air/ground communication (runway use data).

5. Receive runway use data.
   a. Acquire airport status (runway information) on information display system or system status data record.
   b. Receive ground-to-ground communications (runway information).

6. Detect faulty airport environmental sensor.
   a. Search airport environmental instrument for winds, visibility, altimeter, etc.
   b. Evaluate accuracy of information shown on airport environmental instrument.
   c. Initiate ground-to-ground communications (compare readings in tower or other TRACON positions).
   d. Receive ground-to-ground communications (tower/other TRACON position readings).

7. Detect faulty airport environmental sensor.
   a. Cross-reference airport environmental instrument readings with meteorological record information (reported/forecast winds, visibility, altimeter setting, etc.).
   b. Decide whether an airport sensor is faulty based upon available information.

8. Receive general nature NOTAM.
   a. Receive NOTAM on information display system or system status data record.
   b. Receive G.I. message (NOTAM).
   c. Receive ground-to-ground communications (receive NOTAM).

9. Receive airport specific NOTAM.
   a. Receive NOTAM on information display system or system status data record.
   b. Receive G.I. message (NOTAM).
   c. Receive ground-to-ground communications (receive NOTAM).

10. **Request PIREP.**
    a. Perform air/ground communication (request PIREP).

11. **Request controller obtain PIREP.**
    a. Initiate ground-to-ground communications (request controller obtain PIREP).

12. **Forward airport environmental sensor data.**
    a. Initiate ground-to-ground communications (forward winds, visibility, altimeter setting, etc.).

13. **Receive notice of faulty airport environmental sensor.**
    a. Receive ground-to-ground communications (notice of faulty sensor).

14. **Review displayed weather information.**
    a. Acquire weather information and instrument readings on meteorological record, information display system, and/or airport environmental instrument.
    b. Extract pertinent information affecting traffic or terminal operations.

VI. Manage facility/position resources.

A. Brief relieving controllers.

1. Brief relieving controller.
   a. Cross-reference checklist (position) and operational position standard in static information record during relief briefing.
   b. Cross-reference radar display, flight strip bay, display list and data display for display/record information pertaining to traffic, equipment status, airport status, and weather.
   c. Inform relieving controller of traffic, weather, system/equipment/display status).
   d. Inform relieving controller of any pointouts or airspace changes.

2. Verify completeness of relief briefing receipt.
   a. Cross-reference checklist (position) in the static information display to verify completeness of relief briefing.
   b. Assess completeness of relief briefing.

3. Sign off position log.
   a. Execute recording sign on/off log information.

B. Assume position responsibility.

1. Review system status to determine currency/update self.
   a. Acquire system status from information display system or system status data record in status information area.
   b. Acquire system status information system data area on radar display.
   c. Synthesize acquired information with regard to assuming position responsibility.

2. Verify that all required display parameters are in proper location.
   a. Scan radar display and FDIO system for lighting levels, display features, altitude limits, and other settings are adjusted to personal preference or requirements.
   b. Cross-reference parameters on radar display and FDIO system for compliance with facility directive and operational position standard in static information record.

3. Adjust parameters and display/equipment to personal preference.
   a. Execute display control adjustments for personal needs.
   b. Detect changes in appearance character/symbol sizes, brightness, size/shape/location of displays, background shading, and viewports on logical and physical displays.
   c. Assess all visual and audio settings for controller suitability.

4. Check displays/equipment for proper configuration, usability, and satisfactory status.
   a. Search displays/records/equipment for proper location.
   b. Assess for proper configuration/setting of lighting.

5. Review briefing checklist/notes to assure completeness of briefing coverage.
   a. Scan information on controller note.
   b. Extract information from controller note.
   c. Cross-reference pertinent data from checklist (position) in static information record.

    d. Request clarification of data using input message(s) or voice.
    e. Integrate extracted information with regard to assuming position responsibility.
    f. Evaluate completeness of information with regard to assuming position responsibility.
    g. Request clarification of data using input message(s) or voice.

6. Determine if ready to accept control responsibility.
    a. Decide whether or not to assume position responsibility based on the information available.

7. Review current and projected traffic/weather/workload.
    a. Search target position symbol, data block, primary target, secondary target, and precipitation (weather return) on radar display for current/projected traffic.
    b. Search flight progress strip in flight strip bay for current/projected traffic workload.
    c. Acquire surface observation, aviation forecast, in-flight advisory, center weather advisory, and meteorological impact statement in meteorological record for pertinent weather.
    d. Search airport environmental instrument for winds, visibility, altimeter, etc.
    e. Search traffic management record for flow restrictions.
    f. Synthesize extracted information into a mental picture of current and projected traffic and weather status.

8. Receive controller relief briefing.
    a. Receive traffic, weather, and system status briefing from controller verbally.
    b. Cross-reference radar display, flight strip bay, information display system or system status data record, airport environmental instrument, and traffic management record.
    c. Synthesize traffic, weather, and system status information into a mental picture of situation.

9. Sign on position log.
    a. Execute recording sign-on/off log information.

C. Respond to transient ARTS/FDIO failures.

1. Detect non-acceptance of input data.
    a. Recognize lack of feedback/system response to control and/or data inputs.
    b. Search preview area or readout area on radar display for non-acceptance of input data and/or error messages.
    c. Search FDIO monitor and/or flight strip printer on FDIO system for non-acceptance of input data and/or error messages.
    d. Assess failure of ARTS IIA/IIIA system, ARTS II system, and/or FDIO system to accept input data.

2. Receive notice of adjacent facility automation equipment status.
    a. Receive ground-to-ground communications (adjacent system status).
    b. Detect change in equipment status on information display system or system status data record (adjacent facility).

3. Inform supervisor of equipment failure or transient operations.
    a. Initiate ground-to-ground communications (equipment failure/transient operations).

    b. Perform air/ground communication (equipment status).

D. Execute backup procedures for radar display failures.

    1. Forward notice of equipment status.
        a. Initiate ground-to-ground communications (equipment status).
        b. Perform air/ground communication (equipment status).

    2. Receive status of radar display failure.
        a. Receive ground-to-ground communications (radar status).

    3. Observe data base restoration on radar display.
        a. Detect restoration of radar display.

    4. Detect occurrence of radar display failure.
        a. Detect failure of radar display.

E. Execute backup procedures for ARTS/FDIO failures.

    1. Receive confirmation of computer action during transition stages.
        a. Initiate ground-to-ground communications (verify computer actions interfacility and intrafacility during transition stages).
        b. Receive ground-to-ground communications (verification of computer actions during transition stages).

    2. Verify computer action during transition stages.
        a. Recognize operation of data block, target position symbol, display list, preview area, readout area, and geographic map data.
        b. Receive ground-to-ground communications (computer status).
        c. Receive computer status via G.I. message on flight strip printer.

    3. Receive notice of ARTS failure.
        a. Receive ground-to-ground communications (ARTS failure).

    4. Detect occurrence of ARTS/FDIO failure.
        a. Detect malfunction of radar display and/or display control on ARTS IIA/IIIA system or ARTS II system.
        b. Detect malfunction of FDIO monitor to accept input/output data.
        c. Assess nature of malfunction and impact on control capability.

    5. Revert to ARTS/FDIO backup procedures.
        a. Cross-reference checklist and/or position binder in static information record for backup procedures.
        b. Recognize procedures needed to operate in reduced/failed ARTS/FDIO mode.
        c. Initiate ground-to-ground communications (voice backup procedures).
        d. Receive ground-to-ground communications (voice backup procedures).

    6. Revert to ARTS/FDIO reduced capability mode procedures.

    a.  Cross-reference checklist and/or position binder in static information record for reduced capability procedures.

    b.  Recognize procedures needed to operate in reduced system mode.

    c.  Initiate ground-to-ground communications (voice backup procedures).

7.  Revert to ARTS/FDIO reduced capability mode procedures.
    a.  Receive ground-to-ground communications (voice backup procedures).

F.  Execute backup NAVAID procedures.

1.  Determine aircraft needing substitute routing.
    a.  Acquire flight progress strip in flight strip bay (for route information and aircraft needing substitute routing due to NAVAID failure).
    b.  Search status information area for equipment status of NAVAID.
    c.  Acquire arrival/departure list in display list of radar display information on aircraft which may be affected by NAVAID outage.
    d.  Decide on aircraft that will require substitute routing.

2.  Receive substitute routing.
    a.  Receive ground-to-ground communications (substitute routing).
    b.  Receive G.I. message (substitute routing).

3.  Receive cancellation of substitute routing.
    a.  Receive ground-to-ground communications (cancel substitute routing).
    b.  Receive G.I. message (cancel substitute routing).

4.  Discuss appropriateness with supervisor of releasing equipment to maintenance.
    a.  Synthesize weather, traffic management, and airport information into mental picture of current and projected traffic and weather status.
    b.  Assess feasibility and impact of releasing equipment on the basis of current and projected workload, traffic, and weather.
    c.  Initiate ground-to-ground communications (discuss with supervisor appropriateness of releasing equipment to maintenance).
    d.  Receive ground-to-ground communications (discuss with supervisor appropriateness of releasing equipment to maintenance).

5.  Review need/cancellation of substitute routing.
    a.  Evaluate need for substitute routing.
    b.  Initiate ground-to-ground communications (need to cancel or to implement substitute routing).
    c.  Receive ground-to-ground communications (need to implement or to cancel substitute routing).

6.  Request additional pilot report on NAVAID status.
    a.  Perform air/ground communication (need for additional pilot reports on NAVAID status).

7.  Review status of questionable NAVAID.
    a.  Acquire equipment status (NAVAID) in the status information area.

    b.  Initiate ground-to-ground communications (request for supervisor, maintenance, FSS, or ARTCC confirmation of NAVAID status).

    c.  Receive ground-to-ground communications (supervisor, maintenance, FSS, or ARTCC confirmation of NAVAID status).

    d.  Perform air/ground communication (asking for and receiving pilot confirmation of NAVAID status).

8.  Observe substitute routing on record.
    a.  Acquire adapted route usage on information display system.
    b.  Acquire substitute routing from static information record.
    c.  Acquire route, route of flight, or remark information on flight progress strip for indication of new or possible alternate routing for an aircraft.

9.  Receive notice of NAVAID status.
    a.  Receive ground-to-ground communications (notice of NAVAID status).
    b.  Receive G.I. message (notice of NAVAID status).
    c.  Perform air/ground communication (information from pilot regarding status of NAVAID).
    d.  Acquire NOTAM regarding NAVAID status on information display system or system status data record.

10. Forward NAVAID status to others.
    a.  Initiate ground-to-ground communications (NAVAID status).
    b.  Perform air/ground communication (NAVAID status).

11. Forward substitute routing.
    a.  Initiate ground-to-ground communications (substitute routing).
    b.  Perform air/ground communication (substitute routing).

12. Delete previous substitute routing.
    a.  Initiate ground-to-ground communications (notice to delete previous substitute routing).

13. Receive notice of equipment released to maintenance.
    a.  Receive ground-to-ground communications (supervisor notice of equipment released to maintenance).

G.  Execute backup procedures for communication failures/transient operations.

1.  Detect communication failure or transient operation.
    a.  Initiate ground-to-ground communications (problem in initiating a ground-to-ground interphone call).
    b.  Receive ground-to-ground communications (problem receiving or answering a ground-to-ground call).
    c.  Perform air/ground communication (problem receiving or transmitting air/ground radio communications).
    d.  Monitor ATIS voice recording (problem monitoring ATIS).
    e.  Recognize malfunction in system which degrades or prevents communication capabilities.

2. Receive new frequency assignment.
   a. Receive ground-to-ground communications (notice of new frequency assigned).
   b. Receive G.I. message (notice of new frequency assigned).
   c. Acquire frequency assignment in communication channel or communications status on information display system or system status data record.

3. Forward new frequency assignment.
   a. Initiate ground-to-ground communications (advising of new frequency assigned).
   b. Perform air/ground communication (advising pilot of new frequency assigned).

4. Receive notice of alternate communication path.
   a. Receive ground-to-ground communications (alternate communications path).
   b. Receive G.I. message (alternate communications path).
   c. Acquire alternate communications path on communications status on information display system or system status data record.

5. Check status of personal/console communications equipment.
   a. Assess status of personal and console communications equipment.
   b. Decide adequacy of switch setting and parameter indicators on terminal communications equipment.

6. Receive notice of communication status.
   a. Receive ground-to-ground communications (notice of communications status).
   b. Perform air/ground communication (pilot notice of radio status).
   c. Receive G.I. message (notice of communications status).

7. Switch to backup equipment/radio/frequency.
   a. Initiate select backup FAA radio option message.
   b. Execute select backup FAA radio option.
   c. Execute operate emergency battery-powered transceiver.
   d. Initiate ground-to-ground communications (operating commercial telephones in lieu of interphone system).

8. Request communication check from other controller/aircraft/agency.
   a. Initiate ground-to-ground communications (request for communications check).
   b. Perform air/ground communication (request to pilot for communications check).

9. Receive communication check from other controller/aircraft/agency.
   a. Receive ground-to-ground communications (communications check).
   b. Perform air/ground communication (communications check).

10. Forward alternate communication path.
    a. Initiate ground-to-ground communications (alternate communications path).
    b. Execute record system status change for notification to others.
    c. Execute manually transmitted paper record to forward alternate communication path to others.
    d. Initiate enter IDS change indicating alternate communications path.
    e. Execute enter IDS change message.

11. Forward notice of communication status.
    a. Initiate ground-to-ground communications (notice of communications status).

12. Adjust communication path to accommodate failure/overload.
    a. Execute selection of primary/backup FAA radio option, operation of interphone system, or operation of FAA radio.
    b. Initiate ground-to-ground communications (checking radio and interphone capability).
    c. Receive ground-to-ground communications (checking radio and interphone capability).
    d. Perform air/ground communication (checking radio capability).

H. Manage personal workload.

1. Determine impending position overload.
   a. Acquire target position symbol, data block, primary target, secondary target, and precipitation (weather return on radar display for target and weather information.
   b. Acquire flight progress strip on flight progress strip for information pertaining to actual and projected workload levels.
   c. Acquire airport environmental instrument for current winds, altimeter, visibility, etc.
   d. Acquire current/forecast weather from meteorological record to aid in determining current and projected workload levels.
   e. Acquire flow constraints from traffic management record.
   f. Synthesize all traffic and weather information into a mental picture of current and projected workload levels.
   g. Assess individual workload.

2. Request assistance or relief.
   a. Initiate ground-to-ground communications (request for assistance/relief).

3. Request flow control be imposed.
   a. Initiate ground-to-ground communications (request flow constraints).

I. Perform backup procedures for sensor/tracking failures.

1. Inform pilot of radar contact lost.
   a. Perform air/ground communication (radar contact lost).

2. Reassociate data block with target.
   a. Initiate reposition FDB message.
   b. Execute reposition FDB message.
   c. Detect full data block movement on radar display corresponding to entry message.

3. Observe data block not associated with target.
   a. Search radar display to verify that data block associated primary target and/or secondary target.
   b. Detect full data block not associated with primary target on secondary target.

4. Terminate radar service to aircraft.
   a. Perform air/ground communication (terminate radar service).

5. Initiate use of non-radar separation standards.
   a. Acquire flight progress strip in flight strip bay for information pertaining to aircraft separation.
   b. Cross-reference overhead map (or other map) in static information record for route, fix, departure/approach information.
   c. Cross-reference checklist and/or position binder for non-radar separation criteria.
   d. Synthesize position, route, speed, altitude, and aircraft into a mental picture of aircraft separation.
   e. Recognize aircraft paths warranting further close monitoring and evaluation.

6. Initiate use of radar separation standards.
   a. Scan target position symbol, full data block, primary target, secondary target, and mode C altitude on radar display.
   b. Cross-reference range mark and compass rose on radar display.
   c. Detect target position symbol and full data block on radar display entering an area of radar coverage but no radar contact.
   d. Initiate start track or start track file message (initiate a track on aircraft).
   e. Execute start track or start track file message.
   f. Detect appearance of full data block for appropriate aircraft on radar display.
   g. Perform air/ground communication (request pilot to squawk ident).
   h. Search radar display for ident return associated with full data block.
   i. Detect ident return associated with full data block.
   j. Extract aircraft identification in full data block with ident return.

7. Request pilot position reports.
   a. Perform air/ground communication (request pilot position reports).
   b. Initiate ground-to-ground communications (request relay of position report request).

8. Observe return of normal radar environment.
   a. Scan target position symbol, data block, primary target, and secondary target on radar display (to determine return to normal operations).
   b. Cross-reference sweep and antenna strobe on radar display to determine normal operation.
   c. Recognize that radar capabilities have returned to normal.

9. Observe aircraft track in coast mode.
   a. Acquire target position symbol, data block, and coast (symbol) on radar display (for aircraft in coast mode).
   b. Extract aircraft identification and coast status in coast/suspend status list on radar display.

10. Observe ECM interference with presentation of radar target/data block.
    a. Detect jamming and/or interference of analog radar on radar display.
    b. Detect loss or degradation of target returns on radar display.

11. Receive notice that radar has been returned to service.
    a. Receive ground-to-ground communications (radar service restored).
    b. Receive G.I. message (radar service restored).

12. Request readout of assigned/reported beacon code.
    a. Initiate beacon code readout/mode C/speed message.
    b. Execute beacon code readout/mode C/speed message.
    c. Extract beacon code in readout area of radar display.

13. Observe loss of radar target.
    a. Acquire target position symbol, full data block, primary target and secondary target on radar display.
    b. Detect loss of primary target, ground speed, and/or coast full data block.
    c. Detect appearance of new track in coast/suspend list with coast status.

14. Receive notice of radar sensor status.
    a. Receive ground-to-ground communications (radar sensor status).
    b. Receive G.I. message (radar sensor status).

15. Receive procedures to be used to accommodate sensor outage.
    a. Receive ground-to-ground communications (procedures for sensor outage).

16. Perceive tracking or transponder failure.
    a. Search target position symbol, full data block, limited data block, primary target, and secondary target on radar display.
    b. Detect track disassociation, track swap, false return, loss of radar targets, coast indicator, and/or loss of beacon return radar display.
    c. Detect duplicate code characters in data block and/or duplicate code error message in readout area on radar display.
    d. Detect coast status in coast/suspend status list.
    e. Assess whether or not a tracking or transponder failure has occurred.

17. Forward notice of radar sensor status.
    a. Initiate ground-to-ground communications (radar sensor status).

J. Execute backup procedures for loss of flight plan data base.

1. Detect failure to update flight plan data base.
   a. Search flight progress strip in flight strip bay to verify that flight plan data are current.
   b. Recognize updated flight data is not being received from flight strip printer from FDIO system.

2. Verify flight plan data base transition activities.
   a. Acquire full data block on radar display for verification of flight data accuracy during transition.
   b. Acquire flight progress strip in flight strip bay and/or flight strip printer for verification of flight data accuracy during transition.
   c. Initiate ground-to-ground communications (query supervisor to verify flight plan data base).
   d. Receive ground-to-ground communications (receive flight plan data base information from supervisor).
   e. Send G.I. message (query supervisor about flight plan data base).
   f. Receive G.I. message (receive flight plan data base information from supervisor.

g. Evaluate observed flight data for accuracy based on comparison with information received from other sources.

K. Respond to position reconfigurations.

1. Receive notice to take over airspace.
   a. Receive ground-to-ground communications (notice to take over airspace).

2. Receive notice to prepare for position reconfiguration.
   a. Receive ground-to-ground communications (position reconfiguration notice).

3. Receive notice to release airspace.
   a. Receive ground-to-ground communications (notice to release airspace).

4. Observe ARTS reconfiguration.
   a. Detect display list change on radar display as function of ARTS reconfiguration.
   b. Detect sector/center boundary change on video map as function of ARTS reconfiguration.

5. Review system status to determine currency/update self.
   a. Acquire system status from information display system or system status data record in status information area.
   b. Acquire system status information system data area on radar display.
   c. Synthesize acquired information with regard to assuming position responsibility.

6. Verify that all required display parameters are in proper location.
   a. Scan radar display and FDIO system for lighting levels, display features, altitude limits, and other settings are adjusted to personal preference or requirements.
   b. Cross-reference parameters on radar display and FDIO system for compliance with facility directive and operational position standard in static information record.

7. Adjust parameters and display/equipment to personal preference.
   a. Execute display control adjustments for personal needs.
   b. Detect changes in appearance character/symbol sizes, brightness, size/shape/location of displays, background shading, and viewports on logical and physical displays.
   c. Assess all visual and audio settings for controller suitability.

8. Check displays/equipment for proper configuration, usability, and satisfactory status.
   a. Search displays/records/equipment for proper location.
   b. Assess for proper configuration/setting of lighting.

9. Review briefing checklist/notes to assure completeness of briefing coverage.
   a. Scan information on controller note.
   b. Extract information from controller note.
   c. Cross-reference pertinent data from checklist (position) in static information record.
   d. Request clarification of data using input message(s) or voice.
   e. Integrate extracted information with regard to assuming position responsibility.
   f. Evaluate completeness of information with regard to assuming position responsibility.
   g. Request clarification of data using input message(s) or voice.

10. Determine if ready to accept control responsibility.
    a. Decide whether or not to assume position responsibility based on the information available.

11. Review current and projected traffic/weather/workload.
    a. Search target position symbol, data block, primary target, secondary target, and precipitation (weather return) on radar display for current/projected traffic.
    b. Search flight progress strip in flight strip bay for current/projected traffic workload.
    c. Acquire surface observation, aviation forecast, in-flight advisory, center weather advisory, and meteorological impact statement in meteorological record for pertinent weather.
    d. Search airport environmental instrument for winds, visibility, altimeter, etc.
    e. Search traffic management record for flow restrictions.
    f. Synthesize extracted information into a mental picture of current and projected traffic and weather status.

12. Receive controller relief briefing.
    a. Receive traffic, weather, and system status briefing from controller verbally.
    b. Cross-reference radar display, flight strip bay, information display system or system status data record, airport environmental instrument, and traffic management record.
    c. Synthesize traffic, weather, and system status information into a mental picture of situation.